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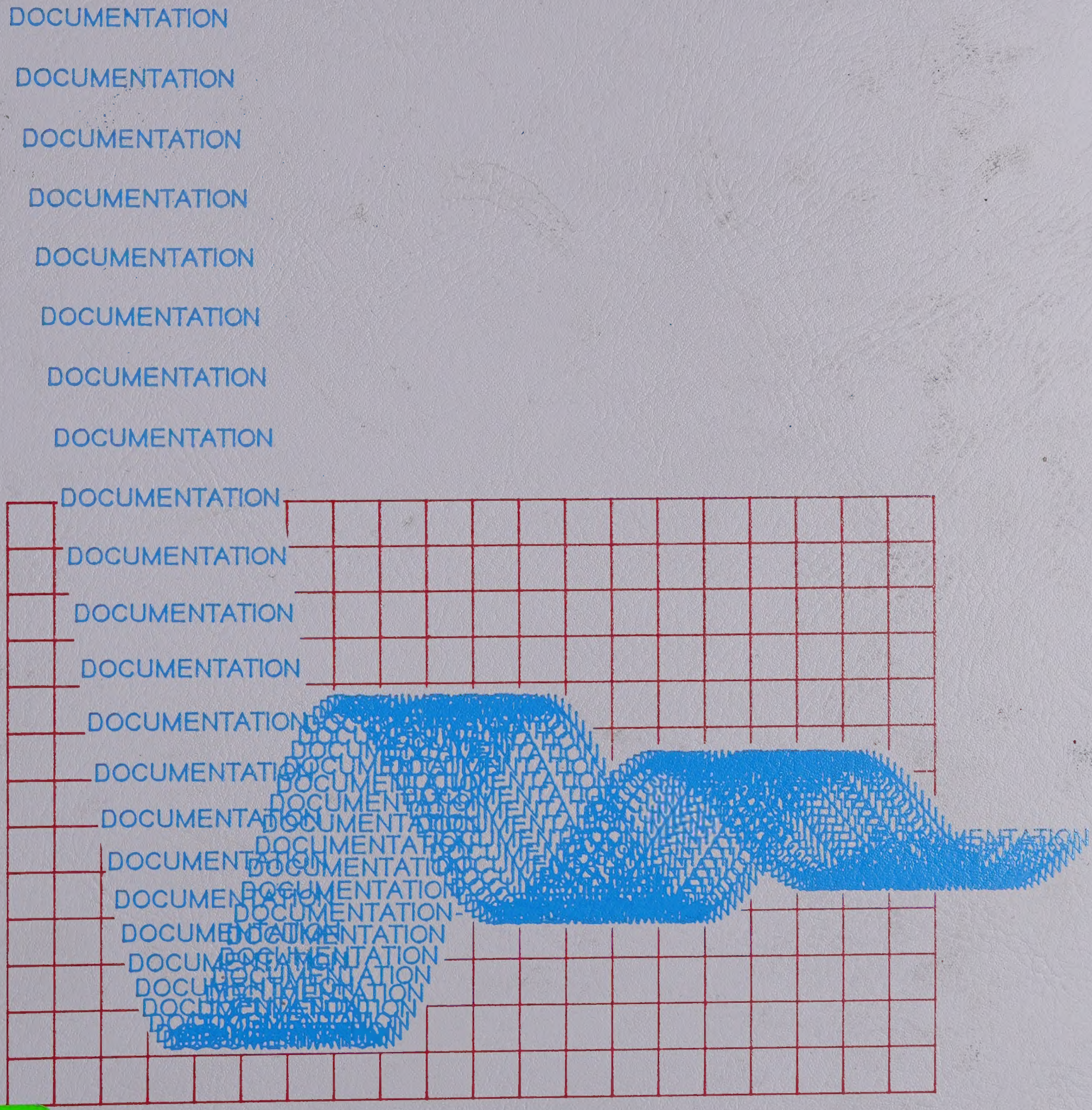
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ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

Software Options:
GSM900/1800/1900 for CMU-B21

CMU-K21/-K22/-K23

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Tabbed Divider Overview

Safety Instructions
Certificate of Quality
List of R&S Representatives

Contents of Manuals for Universal Radio Communication Tester CMU

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Contents of Manuals for Universal Radio Communication Tester CMU

Operating Manual CMU-K21/-K22/-K23 (Software Options: GSM900/1800/1900 for CMU-B21)

The present operating manual describes the application of CMU for GSM mobile tests. It gives comprehensive information about the installation of the software, about the operating concept and about manual and remote control of CMU. Typical measurement tasks are explained in detail using the functions offered by the graphical user interface and a selection of program examples.

The manual is subdivided into 8 chapters:

Chapter 1	describes the steps necessary for installing the software and putting the instrument into operation.
Chapter 2	gives an introduction to the application of CMU for GSM mobile tests and presents some typical measurement examples.
Chapter 3	describes the operation in principle and the principles of measurement control.
Chapter 4	serves as a reference of all functions of the user interface and their application. Allowed settings, default values and the corresponding remote control commands are listed for all functions.
Chapter 5	describes the basics of remote control of the instrument for GSM mobile tests.
Chapter 6	lists all remote control commands defined for GSM mobile tests. At the end of the chapter the commands are grouped together according to their function and sorted by alphabetical order.
Chapter 7	contains program examples.
Chapter 10	contains an index for the operating manual.

Operating Manual CMU

In the operating manual for CMU basic unit you will find information about the technical specifications of CMU, the controls and connectors on the front and rear panel, necessary steps for putting the instrument into operation, the basic operating concept, manual and remote control. Typical measurement tasks are explained in detail using the functions of the user interface and program examples.

Service Manual Instrument

The service manual instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for the maintenance of CMU by exchanging modules.

Service Manual Modules

The service manual modules is not delivered with the instrument but may be obtained from your R&S service department using the order number 1100.4903.91.

Service manual modules contains information about the individual modules of CMU. This comprises the test and adjustment of the modules, fault detection within the modules and the interface description.

Frequently Used Abbreviations

AB	Access Burst
Abs.	Absolute
AGC	Automatic Gain Control
AOC	Advice of Charge
Att.	Attenuation
Autom.	Automatic(ally)
BA	BCCH Allocation
Bandw.	Bandwidth
BCC	Base Transceiver Station Color Code
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BS	Base (Transceiver) Station
BS-AG-BLKS-RES	Basic Services Access Grant Blocks Reserved
BS-PA-MFRMS	Basic Service Paging Blocks Available per Multiframes
BTS	Base Transceiver Station
CCH	Control Channel
Chan.	Channel
Config.	Configuration
CRC	Cyclic Redundancy Check
DAI	Digital Audio Interface
Disp.	Display Mode
Disp.	Display
DTX	Discontinuous Transmission (Mode)
Err.	Error
Ext.	External
FAC	Final Assembly Code
FACCH	Fast Associated Control Channel
FER	Frame Erasure Rate
Freq.	Frequency
GSM	Global System for Mobile Communication, Groupe Spécial Mobile
IF	Intermediate Frequency
IMEI	International Mobile Station Equipment Identity
IMSI	International Mobile Subscriber Identity
Lev.	Level
Max./Min.	Maximum/Minimum
MCC	Mobile Country Code
MNC	Mobile Network Code
MOC	Mobile Originated Call
MS	Mobile Station
MSIN	Mobile Subscriber Identity Number
MTC	Mobile Terminated Call
NB	Normal Burst
PCL	Power Control Level
Ph.	Phase
Pop.	Popup Menu
PRBS	Pseudo Random Bit Sequence
PSR	Pseudo Random
RACH	Random Access Channel
RBER	Residual Bit Error Rate
Rcv.	Receiver
Ref.	Reference
Rel.	Relative
RF	Radio Frequency
RMS	Root Mean Square (averaging)
SDCCH	Stand-alone Dedicated Channel
Seq.	Sequence
SMS	Short Message Service
SNR	Serial Number
SVN	Software Version Number
TAC	Type Approval Code
TCH	Traffic Channel
TDMA	Time Division Multiple Access
Trg.	Trigger
Trg. Src.	Trigger Source
TSC	Training Sequence (Code)

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Installing the Software 1.1

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1 Installation and First Steps

This chapter describes how to update the firmware containing the software options GSM900/1800/1900 for the Universal Radio Communication Tester CMU.

Before proceeding to perform any of the steps described in this manual, please make sure that the instrument is properly connected and put into operation according to the instructions given in chapter 1 of the CMU manual. The hardware and software options available are shown in the *Startup* menu. The entries "CMU-K21 GSM900-MS, CMU-K22 GSM1800-MS, CMU-K23 GSM1900-MS" indicate the status of the software options required for GSM mobile tests:

Installing the Software

The CMU is equipped with either a 3.5" floppy disk drive or a PCMCIA interface. The installation process depends on the storage medium that can be read by your instrument. It is controlled by a software tool, the VersionManager.

Installation from a Set of Floppy Disks

The installation kit for software option GSM900/1800/1900 consists of a set of numbered floppy disks.

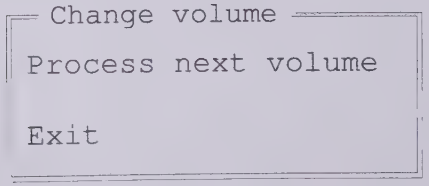
To install the software proceed as follows:

- ➢ Switch off the CMU,
- ➢ Insert the disk no. 1 into the floppy disk drive of your CMU,
- ➢ Switch on the CMU,

The installation is started automatically while the CMU performs its start-up procedure. To this end the VersionManager is called up.

- ➢ Use the softkeys on the left side of the display to select the option *Install new software version.*
- ➢ If more than one version or more than one installation medium is available, use the softkeys again to select the desired version/installation medium.

The installation is started. To indicate that the floppy disk must be changed the CMU issues the *Change volume* message:



```
Change volume
Process next volume

Exit
```

- ➢ Replace the current disk with the disk requested.
- ➢ Use the cursor up/down keys to select "Process next volume" (default setting).
- ➢ Press *ENTER* to confirm that the new disk has been inserted and to continue the installation.

To monitor the installation process the CMU displays messages such as:

```
...Volume # 1 has been processed
...Volume # 2 to be installed next
```

After processing the last floppy disk the CMU displays the messages:

```
...Installation completed
...please remove the installation media to reboot
...press any key to continue
```

➢ Remove the disk and press any key to reboot the CMU.

The CMU reboots and performs a firmware update of the hardware modules. This may take a few minutes. Afterwards the new software version is started and the instrument is ready to operate.

Installation from a PCMCIA Card

To be read by the CMU's card drive it must be copied to an appropriate storage medium (a flash disk or a PCMCIA hard disk).

The installation process is analogous to the installation from a set of floppy disks.

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- Receiver Reports and Power Measurements 2.20
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2 Getting Started

The following chapter presents a sample GSM mobile test with the universal radio communication tester CMU. It is intended to provide a quick overview of the function groups *GSM900/1800/1900-MS Non Signalling* and *GSM900/1800/1900-MS Signalling* and their functionality and to lead through the most common tests which are performed on GSM mobile phones.

Before starting any measurement with the CMU, please note the instructions given in chapter 1 of the operating manual for the CMU basic unit for putting the instrument into operation. In chapters 2 to 4 of that manual you will also find information on customizing the instrument and the display according to your personal preferences. For installation instructions for the GSM900/1800/1900 software (CMU-K21/-K22/-K23) refer to chapter 1 of the present manual.

The tests reported below include

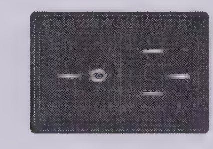
- connection of the phone and selection of the GSM function group,
- power and modulation measurements in *Non Signalling* mode,
- selection and measurement of signalling parameters,
- BER tests.

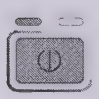
The steps to perform are explained on the left side of each double-page together with the results obtained on the CMU screen. On the right side, additional information is given. We also point out alternative settings and related measurements which could not be reported in detail.

The principles of manual operation are discussed in chapter 3. For a systematic explanation of all menus, functions and parameters including GSM background information refer to the reference part in chapter 4.

Preparing a GSM Mobile Phone Test

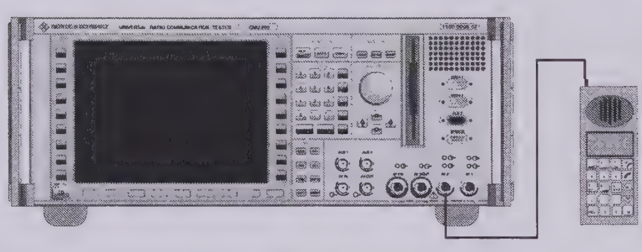
This chapter describes how to use the CMU for GSM mobile phone tests. As a prerequisite for starting the session, the instrument must be correctly set up and connected to the AC power supply as described in chapter 1 of the operating manual for the CMU basic unit. Furthermore, the GSM software must be properly installed following the instructions given in chapter 1 of the present manual.





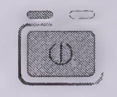
Step 1

- ➢ Switch on the CMU using the mains switch at the rear. ①
- ➢ Check the operating mode of the instrument at the *ON/STANDBY* key on the front panel.②



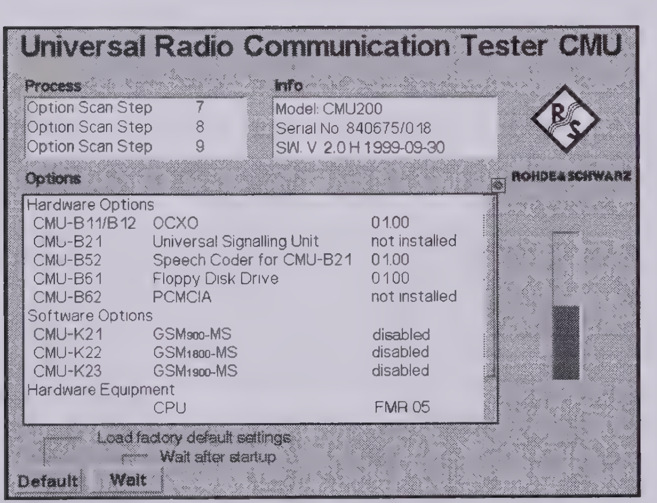
Step 2

- ➢ Connect the bi-directional RF connector RF 2 of the CMU to the antenna connector of the mobile phone. ③
- ➢ Supply the mobile phone with the correct operating voltage (battery or power supply).④



Step 3

- ➢ Switch on the CMU by means of the *ON/STANDBY* key on the front panel.



```
Universal Radio Communication Tester CMU
Process                          Info
Option Scan Step      7          Model: CMU200
Option Scan Step      8          Serial No 840675/018
Option Scan Step      9          SW. V 2.0 H 1999-09-30
Options
Hardware Options
 CMU-B11/B12   OCXO                      01.00
 CMU-B21       Universal Signalling Unit not installed
 CMU-B52       Speech Coder for CMU-B21  01.00
 CMU-B61       Floppy Disk Drive         01.00
 CMU-B62       PCMCIA                    not installed
Software Options
 CMU-K21       GSM900-MS                 disabled
 CMU-K22       GSM1800-MS                disabled
 CMU-K23       GSM1900-MS                disabled
Hardware Equipment
               CPU                       FMR 05
      Load factory default settings
           Wait after startup
Default   Wait
```

The startup menu is displayed while the CMU performs a power-up test. ⑤

After a few seconds the CMU displays the last menu used in the previous session.

- ➢ Press the *RESET* key to open the *Reset* popup menu.
- ➢ Select *Reset* and press the *ENTER* key.
- ➢ In the popup window opened, select *Yes* to confirm the instrument reset.

The CMU indicates that it performs a general reset of all device settings and is then ready to carry out the following steps. The *Reset* popup menu is closed automatically.

Additional Information...

... on Step 1

① **Mains switch on the rear panel**

When the mains switch at the rear is set to the OFF position, the complete instrument is disconnected from the power supply. When the mains switch is set to the ON position, the instrument is in standby mode or in operation, depending on the position of the mains switch on the front panel.

② ***ON/STANDBY* key on the front panel**

The *ON/STANDBY* key at the front of the instrument determines whether the instrument is in standby mode or in operation.

Standby mode:
Only the reference frequency oscillator is supplied with operating voltage, and the orange LED (STANDBY) is illuminated.

Operation:
The green LED (ON) is illuminated and all modules of the instrument are supplied with operating voltage.

... on Step 2

③ **RF connection of the mobile phone**

A high-quality cable should be used for this connection, ideally with an attenuation of less than 0.5 dB. For portable phones, the car installation set supplied by telephone manufacturers can be used.

④ **Power supply for the mobile phone**

In case the mobile phone is operated from an external power supply, make sure that it is capable of supplying the maximum peak current required. As GSM mobile phones generate pulse-like RF signals, they often feature a pulse-shaped current consumption. Problems may arise if power supplies are used which cannot provide such currents with a constant voltage.

... on Step 3

⑤ **Startup menu**

The startup menu displays the following information:

- the status of the startup test *(Process),*
- the device name, serial number and software version *(Info),*
- the options and equipment installed *(Options),*
- the progress of the startup test (*Startup* bar graph).

Alternative Settings and Measurements

☞ chapter 1 of CMU manual

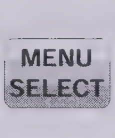
The CMU provides two bidirectional RF connectors RF1 and RF2 differing by their permissible input and output levels. RF1 is the recommended standard connector for GSM mobile phones, RF2 for handheld phones (see data sheet).

The unidirectional connectors RF4 IN and RF3 OUT are intended for connection of modules requiring high input levels or modules with low RF output levels. RF4 IN and RF3 OUT can also be used to connect GSM mobiles off the air via antennas.

Input and output connectors can be selected in the *RF* ⊙→ index card of the *Connect. Control* menu.

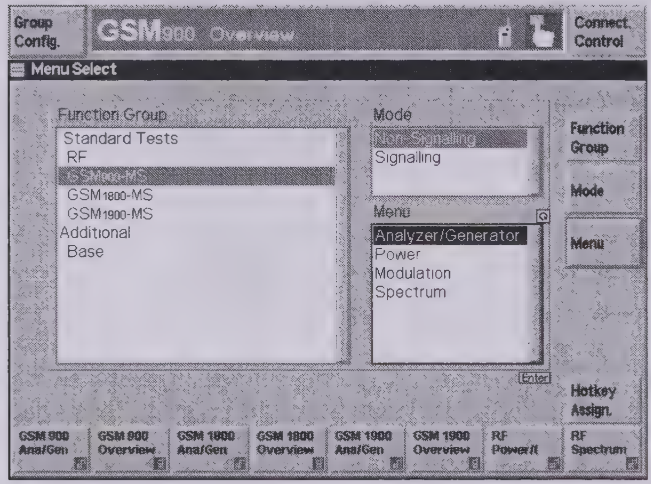
☞ chapter 4 of CMU manual

That chapter also contains information on customizing the CMU.


MENU
SELECT

Step 4

- ➢ Press the *Menu Select* key to open the *Menu Select* menu.①


Group Config.
GSM900 Overview
Connect. Control
Menu Select
Function Group
Standard Tests
RF
GSM900-MS
GSM1800-MS
GSM1900-MS
Additional
Base
Mode
Non-Signalling
Signalling
Menu
Analyzer/Generator
Power
Modulation
Spectrum
Enter
Function Group
Mode
Menu
Hotkey Assign.
GSM 900 Ana/Gen
GSM 900 Overview
GSM 1800 Ana/Gen
GSM 1800 Overview
GSM 1900 Ana/Gen
GSM 1900 Overview
RF Power/t
RF Spectrum

The *Menu Select* menu indicates the function groups available. If a function group is selected the corresponding modes and measurement menus are indicated.

- ➢ Select the GSM900-MS function group.
- ➢ Select the *Non-Signalling* mode
- ➢ Select the *Analyzer/Generator* menu.
- ➢ Press the *Enter* key to activate the measurement selected and open the *Analyzer/Generator* menu.

Additional Information...

... on Step 4

① **Menu Select menu**

The *Menu Select* menu shows all function groups installed on your CMU. Function Group GSM900/1800/1900-MS is subdivided in the two measurement modes *Non Signalling* and *Signalling*, each containing a number of measurement menus.

Alternative Settings and Measurements

☞ chapter 3

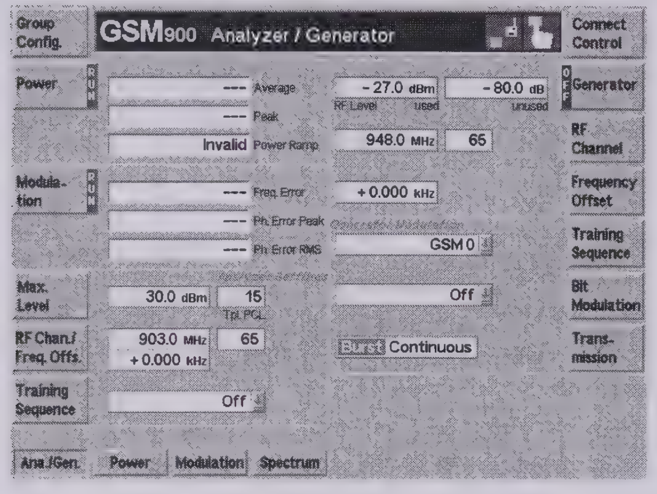
☞ chapter 4

Frequently used measurement menus can be stored together with their function group and mode and assigned to one of the eight hotkeys. When needed for the next time, they can be called up by a single keystroke.

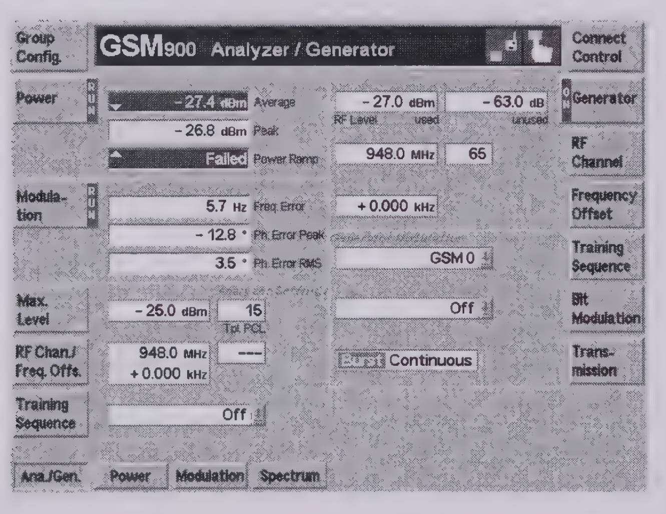
Non Signalling Mode

In the *Non Signalling* mode, a GSM-specific RF signal can be generated and a RF signal with GSM characteristics analyzed. Compared to the *Signalling* mode test times may be reduced considerably. The most common application is module test and test of mobiles in a special "test mode".

In our example we use the GSM signal generated by the CMU itself to demonstrate the main features of the non signalling mode. This is analogous to the *RF* measurement example in the operating manual for CMU200 and illustrates the extended functionality of the GSM function groups.


Group Config.
GSM900 Analyzer / Generator
Connect Control
Power
Modulation
Max. Level
RF Chan./ Freq. Offs.
Training Sequence
Generator
RF Channel
Frequency Offset
Training Sequence
Bit Modulation
Trans-mission
Ana./Gen.
Power
Modulation
Spectrum

Average: ---
Peak: ---
Power Ramp: Invalid
Freq. Error: ---
Ph. Error Peak: ---
Ph. Error RMS: ---
RF Level used: -27.0 dBm; unused: -80.0 dB
948.0 MHz 65
+0.000 kHz
GSM 0
Off
Burst Continuous
Max. Level: 30.0 dBm; Tpl. PCL: 15
RF Chan./Freq. Offs.: 903.0 MHz +0.000 kHz 65
Training Sequence: Off


Group Config.
GSM900 Analyzer / Generator
Connect Control
Power
Modulation
Max. Level
RF Chan./ Freq. Offs.
Training Sequence
Generator
RF Channel
Frequency Offset
Training Sequence
Bit Modulation
Trans-mission
Ana./Gen.
Power
Modulation
Spectrum

Average: -27.4 dBm
Peak: -26.8 dBm
Power Ramp: Failed
Freq. Error: 5.7 Hz
Ph. Error Peak: -12.8 °
Ph. Error RMS: 3.5 °
RF Level used: -27.0 dBm; unused: -63.0 dB
948.0 MHz 65
+0.000 kHz
GSM 0
Off
Burst Continuous
Max. Level: -25.0 dBm; Tpl. PCL: 15
RF Chan./Freq. Offs.: 948.0 MHz +0.000 kHz ---
Training Sequence: Off

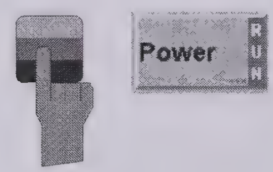
Step 1

The *Analyzer/Generator* menu indicates the parameters of the signal generated and of the signal received and analyzed by the CMU. ②

In particular, the current measurement results for power, frequency and phase errors of the received signal are displayed. ③

At present, all parameters are set to their default values. They can be changed directly in the *Analyzer/Generator* menu. User-defined parameters will be saved for later sessions when the CMU is switched off.

- ➢ Press the *Generator* softkey and the *ON/OFF* key to switch on the generator.
- ➢ Proceed as outlined in section *RF Non Signalling Measurements,* chapter 2 of CMU200 operating manual to connect RF3 to RF 4 via a coax cable. Open the *Connection Control* menu and perform the appropriate RF input and output settings.
- ➢ Adapt the *Max. Level* setting to the expected signal level, i.e. to the RF Level in the used timeslot (–27 dBm) plus an appropriate margin.



- ➢ Select (press) the *Power* softkey.

Additional Information...

... on Step 1

② **Analyzer/Generator menu**

The *Analyzer/Generator* menu contains three configuration panels used for

- control of signals received and analyzed by the CMU *(Analyzer Settings),*
- control of signals generated *(Generator Settings),*
- definition of the bit content of generated signals *(Generator Modulation).*

The assignment between carrier frequency and channel number is according to GSM specifications. As the CMU simulates a base station, the generator signal corresponds to the downlink (signal direction from the base station towards the mobile station), the signal analyzed corresponds to the uplink (signal direction from the mobile station towards the base station). The channel/frequency assignment changes accordingly.

In general, the RF generator level is set to be different for the used timeslot and unused timeslots. The level of the unused timeslots is defined relative to the level in the used timeslot.

③ The status indication of the *Power* and *Modulation* measurements and of the RF Generator is included in the corresponding softkeys. For ongoing measurements, the results in the output fields are constantly updated.

All measured quantities refer to the current burst. The default tolerance template for the power ramp is defined in the GSM specifications.

Alternative Settings and Measurements

☞ chapter 4

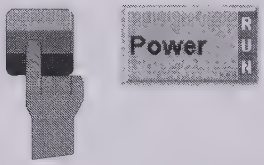
The three configuration panels are equivalent to the *Signal* index card of the *Connection Control* menu.

Selecting a definite training sequence (TSC) or bit modulation or transmission mode in the *Generator Modulation* panel implies that signals with these characteristics are generated.

Selecting a definite TSC in the *Analyzer Settings* panel implies that only signals with this TSC are analyzed.

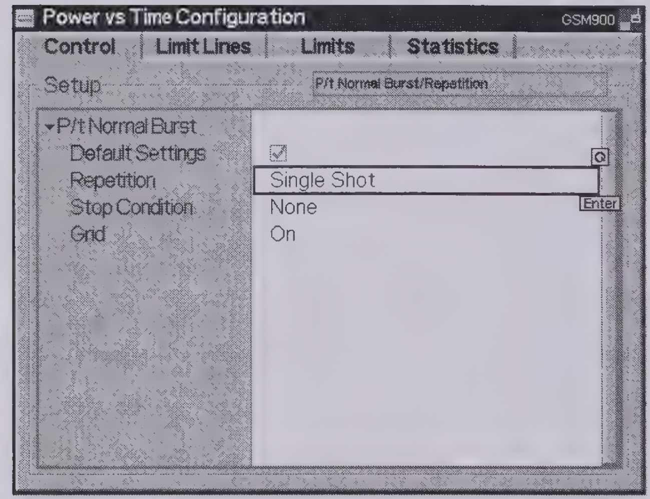
The current options for the measurement status are *ON* (default) and *OFF*. A third status, *HLT*, applies to single shot measurements (see below, step 2).

Once selected, the Power or Modulation measurement is switched off and on again by means of the toggle key *ON/OFF*.



Step 2

- ➢ Press the selected *Power* softkey again to call up the *Power vs Time Configuration* menu.


Power vs Time Configuration
GSM900
Control
Limit Lines
Limits
Statistics
Enter

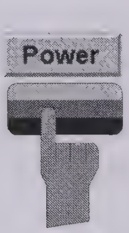
Setup P/t Normal Burst/Repetition

▾P/t Normal Burst
Default Settings ☑
Repetition Single Shot
Stop Condition None
Grid On

The *Power vs Time Configuration* menu defines the scope of the power ramp measurement. The settings offered in this menu are discussed in section *General Settings* in chapter 3. We pick just one example, limiting the number of bursts measured.①

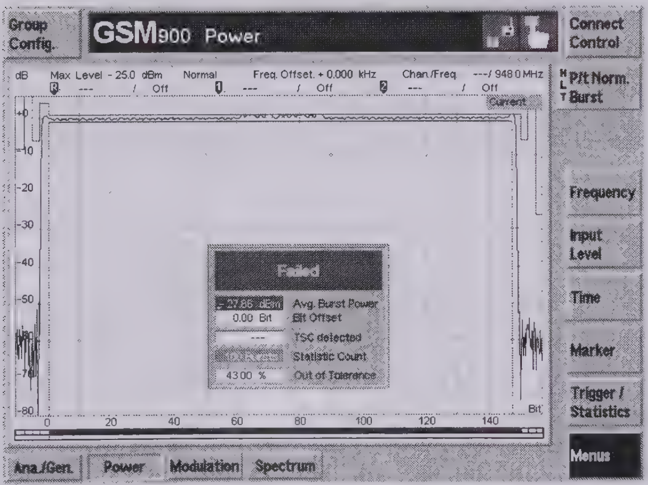
- ➢ Press the *ON/OFF* key or the rotary knob to expand the table.
- ➢ Select *Single Shot* in the *Repetition* line.②
- ➢ Press the *ESCAPE* key or the *Power* softkey again to close the *Power vs Time Configuration* menu and return to the main menu.

The Power measurement is stopped after one statistic count. The status indication next to the *Power* softkey is set to *HLT*.③



Step 3

- ➢ Press the *Power/t* hotkey to switch over to the graphical menu *Power vs Time*.


Group Config.
GSM900 Power
Connect Control
P/t Norm. Burst
HLT
Current
dB
+0
-10
-20
-30
-40
-50
-70
-80
0
20
40
60
80
100
120
140
Bit
Frequency
Input Level
Time
Marker
Trigger / Statistics
Menus
Ana./Gen.
Power
Modulation
Spectrum

Max Level - 25.0 dBm Normal Freq. Offset. + 0.000 kHz Chan./Freq. ---/ 948.0 MHz
R --- / Off 1 --- / Off 2 --- / Off

Failed
-27.86 dBm Avg. Burst Power
0.00 Bit Bit Offset
--- TSC detected
Statistic Count
43.00 % Out of Tolerance

The *Power vs Time* menu shows the power of the current burst as a function of time. ④

Together with the burst power, a tolerance template as specified in the GSM standard is displayed. Settings (at present, the default settings) and scalar results are displayed in two parameter lines above the diagram and in a message box positioned in the center of the diagram.

Various tools allowing to take a closer look at the measurement results are provided in the graphical measurement menu.

Additional Information...

... on Step 2

① **Power vs Time Configuration menu**

The *Power vs Time Configuration* menu contains three index cards defining

- the repetition mode and stop condition *(Control),*
- the limit lines *(Limit Lines),*
- the display mode and statistic count *(Statistics)* of the power ramp measurement.

② **Repetition mode and Stop Condition**

If no stop condition is imposed *(Stop Condition = None),* the *Repetition* mode determines whether the measurement is

- continued until explicitly stopped by the operator *(Continuous),*
- stopped after one statistic count *(Single Shot).*

By default, a statistic count comprises 100 bursts. With *Stop Condition = On Limit Failure*, the measurement is stopped after the first burst which is out of tolerance.

③ **Measurement in the HLT state**

The average and peak power of the last burst measured is indicated in the output fields *Average* and *Peak*.

In contrast, the modulation measurement is still running. The results for the frequency and phase errors are periodically updated.

... on Step 3

④ **Power vs Time menu**

The diagram in the *Power vs. Time* menu shows a normal burst with a length of 148 bits (plus a guard period of 8.25 bits). The time scale of the diagram ranges from –10 bits to 160 bits covering the useful part, the rising and falling edges of the burst. The ordinate ranges from –80 dB to +10 dB, the 0-dB reference level is equal to the carrier power.

Note that settings made previously (*Power vs Time Configuration* menu) are preserved in the whole measurement group. Accordingly, the status of the measurement is still *HLT.* The diagram is fixed showing the last burst measured.

Alternative Settings and Measurements

☞ chapter 3.

Settings made in the *Power vs Time Configuration* menu apply to power measurements only.

Settings made in *the Group Config.* and *Connect. Control* menus apply to the entire function group and mode GSM900-MS Non Signalling.

☞ chapter 3.

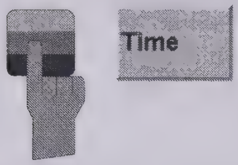
The *statistic count* is defined in the Statistics index card of the *Power vs Time Configuration* menu.

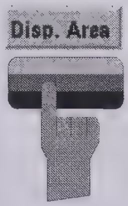
The stop condition *On Limit Failure* should be selected if the limit check represents the main purpose of the measurement.

The limits can be modified in the *Limit Lines* index card of the *Power vs Time Configuration* menu.

☞ chapter 4.

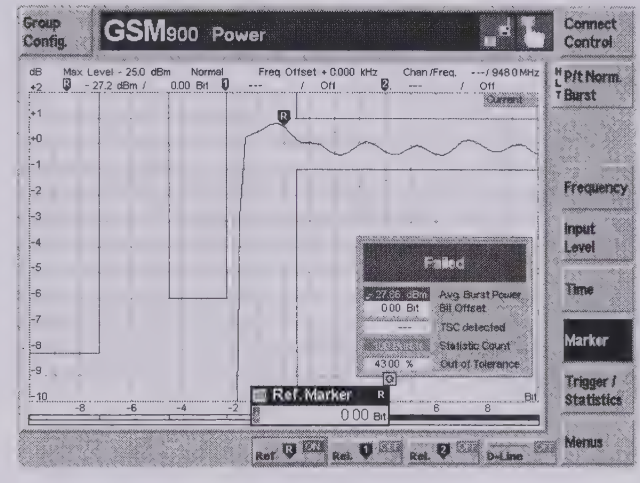
The GSM power template is generally defined relative to the carrier power. For low signal powers, a looser absolute limit is to be applied at the beginning and the end of the power ramp (areas 1, 2, 7, and 8). This yields the distorted template that we observe in the present example.





Step 4

- ➢ Press the *Time* softkey to change the hotkeys displayed below the diagram.①
- ➢ Press the *Disp. Area* hotkey to open a window offering a list of different zoom areas.

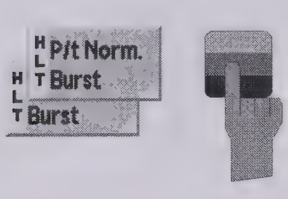

Group Config.
GSM900 Power
Connect Control
dB Max. Level - 25.0 dBm Normal Freq. Offset + 0.000 kHz Chan./Freq. ---/ 948.0 MHz
+2 - 27.2 dBm / 0.00 Bit --- / Off --- / Off
Current
P/t Norm. Burst
Frequency
Input Level
Time
Marker
Trigger / Statistics
Menus
Failed
- 27.86 dBm Avg. Burst Power
0.00 Bit Bit Offset
--- TSC detected
Statistic Count
43.00 % Out of Tolerance
Ref. Marker
0.00 Bit
Ref. Rel. Rel. D-Line

If you select *Left Upper Corner* the CMU zooms in on the left upper corner of the burst.

- ➢ Press the *Marker* softkey and the *Ref R* hotkey. Enter an abscissa value (in bits) to position a reference marker onto the trace.②

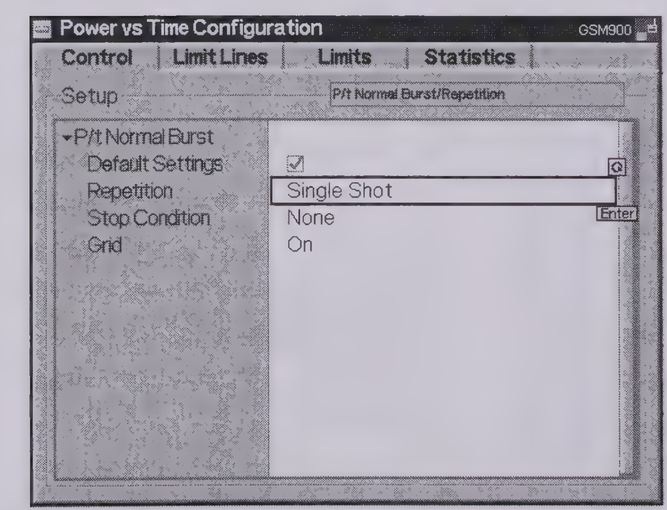
The coordinates (time and burst power) of the reference marker are displayed in the second parameter line.

For the next step we'll take advantage of the fact that the configuration menu is accessible from the graphical menu as well.


P/t Norm. Burst
Burst

Step 5

- ➢ Press the *Power/t Norm. Burst* softkey twice to reopen the *Power vs Time Configuration* menu.


Power vs Time Configuration GSM900
Control
Limit Lines
Limits
Statistics
Enter

Setup P/t Normal Burst/Repetition

▾P/t Normal Burst
Default Settings ☑
Repetition Single Shot
Stop Condition None
Grid On

- ➢ Select *Continuous* from the *Repetition* group of toggle switches to restart the measurement and confirm with *ENTER* or by pressing the rotary knob.
- ➢ Select the *Statistics* index card.
- ➢ Press *ENTER* or the rotary knob to expand the table.
- ➢ From the *Display Mode* field, select *Maximum.*③
- ➢ Press *ESCAPE* or the *P/t Norm. Burst* softkey to close the configuration menu.

Instead of the current burst power, the maximum burst power measured at each time is shown in the diagram. As no stop condition is set, the measurement will be running until explicitly terminated.

Additional Information...

... on Step 4

① **Softkeys and hotkeys**

To enlarge the diagram area of the graphical measurement menus the left softkey column is suppressed. The functionality of each softkey on the right side is extended by hotkeys assigned to the softkeys. These hotkeys are displayed across the hotkey bar below the diagram when the softkey is selected.

Some of the softkey/hotkey combinations offer settings that can be also accessed via configuration menus. For example, the settings offered by the *Input Level* softkey are equivalent to the *Input Level* index card in the *Group Configuration* menu. However the *Group Configuration* menu offers global settings, whereas an input level set in the *Power vs Time* menu is valid for power measurements only.

② **Markers**

Markers are a graphical tool used to locate points on a trace and read out their coordinates. A reference marker and two delta markers may be defined in the *Power vs Time* menu.

The reference marker R measures the absolute level of the trace, the delta markers 1 and 2 measure the absolute level or (if set to relative) the distance between their position and the reference marker.

... on Step 5

③ **Display mode**

If the measurement extends over several bursts the CMU calculates four different traces one of which can be selected in the *Display Mode* panel. The purpose of the four traces is to give an overview of the range and arithmetic mean of the levels detected at any point on the time axis. The following traces can be displayed:

Current	the current burst level
Maximum	the maximum of all burst levels measured
Minimum	the minimum of all burst levels measured
Average	the average of all burst levels measured in the last statistic count.

The *Statistic Count* input field defines how many evaluation periods form a statistics cycle. For GSM *Non Signalling* measurements an evaluation period is equal to the propagation time of a normal burst (this definition holds even if a continuous carrier signal is transmitted). In our example the statistics cycle comprises 100 Bursts (default value).

Alternative Settings and Measurements

☞ chapter 4.

The *Frequency* softkey defines the frequency and channel of the measured signal.

The *Input Level* softkey configures the input level and external attenuation.

The *Time* softkey defines the time axis and the zoom area.

The *Marker* softkey sets markers and D-lines.

The *Trigger/Statistics* softkey sets the trigger condition and the display mode.

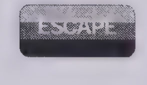
☞ chapter 4.

In addition to markers, a D-line can be used to measure a particular level in the diagram.

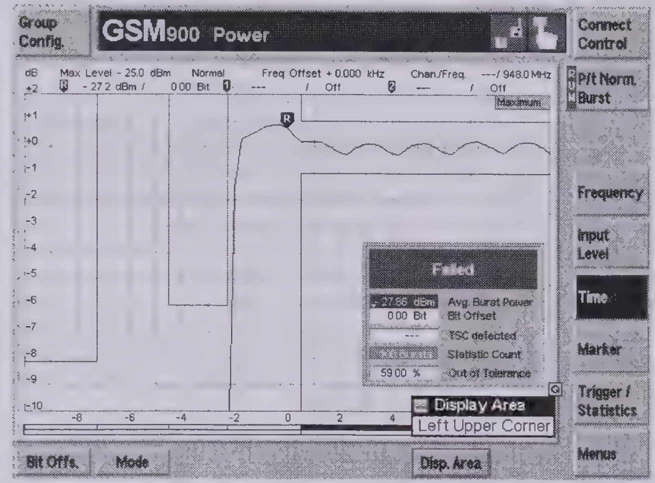
☞ chapter 3.

To refine the statistical evaluation, a suitable combination of the statistic count, repetition mode, stop condition and display mode should be selected.

Step 6



- ➢ Press the ESCAPE key to close the *Power vs Time Configuration* menu and return to the main menu.


Group Config.
GSM900 Power
Connect Control
P/t Norm. Burst
Maximum
R
1
2
dB
+2
+1
+0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-8
-6
-4
-2
0
2
4
Frequency
Input Level
Time
Marker
Trigger / Statistics
Menus
Bit Offs.
Mode
Disp. Area

Max Level - 25.0 dBm Normal Freq Offset + 0.000 kHz Chan./Freq. ---/ 948.0 MHz

R - 27.2 dBm / 0.00 Bit 1 --- / Off 2 --- / Off

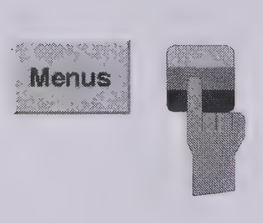
Failed

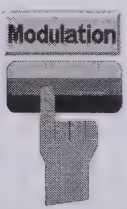
- 27.86 dBm Avg. Burst Power
0.00 Bit Bit Offset
--- TSC detected
Statistic Count
59.00 % Out of Tolerance

Display Area
Left Upper Corner

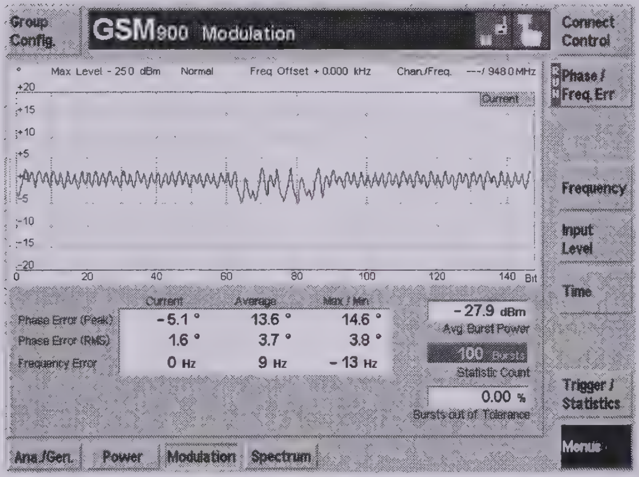
The trace is now continuously measured and updated in the display. With the display mode *Maximum* trace values will be replaced only if a current measured value at a particular test point exceeds all values measured previously at the same test point.

Step 7




Modulation

- ➢ Press the *Menus* softkey to display the measurement groups available in the hotkey bar.
- ➢ Press the *Modulation* hotkey to open the *Modulation* menu.


Group Config.
GSM900 Modulation
Connect Control
Phase / Freq. Err
Current
°
+20
+15
+10
+5
-5
-10
-15
-20
0
20
40
60
80
100
120
140
Bit
Frequency
Input Level
Time
Trigger / Statistics
Menus
Ana./Gen.
Power
Modulation
Spectrum

Max Level - 25.0 dBm Normal Freq Offset + 0.000 kHz Chan./Freq. ---/ 948.0 MHz

	Current	Average	Max / Min
Phase Error (Peak)	- 5.1 °	13.6 °	14.6 °
Phase Error (RMS)	1.6 °	3.7 °	3.8 °
Frequency Error	0 Hz	9 Hz	- 13 Hz

- 27.9 dBm Avg. Burst Power
100 Bursts Statistic Count
0.00 % Bursts out of Tolerance

The *Modulation* menu displays the results of the phase and frequency error measurement.①

The trace represents the phase error of the current burst as a function of time.②

Below, a table displays the frequency error, the extreme value of the phase error and the RMS phase error.③

The average power of the current burst and the statistic count are shown in addition.

Additional Information...

... on Step 7

① **Phase and frequency errors**

GSM specifies a particular type of modulation (GMSK). The bits to be transmitted translate into the phase information of the RF signal. It is important that this modulation is adhered to as strictly as possible. GSM specifies a peak phase error of max. 20 °, a rms-weighted phase error of max. 5 ° and a frequency error of max. 0.05 ppm of the transmit frequency.

The limits may be modified in the *Limits* index card of the *Modulation Configuration* Menu which is opened by pressing the selected *Phase/Freq. Error* softkey once again. The *Modulation Configuration* menu is analogous to the *Power Ramp Configuration* menu explained on the previous pages. According to the requirements of the measurements the two configuration menus differ in two points:

- Phase errors are relevant within the useful part of the burst. Therefore, a fixed upper and lower limit for the phase error is specified. It is not necessary to discriminate between different areas of the burst (see item ② below).
- The absolute value of the phase error is a measure of the quality of modulation, whereas the sign is of secondary interest. This is why the display modes *Minimum* and *Maximum* can not be selected separately, the CMU displays the extreme values instead (display mode *Minimum/Maximum*).

② **Measurement trace**

The diagram in the *Modulation* menu shows the useful part of a normal burst with a length of 148 bits, The time scale of the diagram, ranging from 0 bits to 148 bits, is thus shorter than in the *Power vs. Time* diagram. The ordinate is symmetric around 0 °, ranging from –20 dB to +20 dB.

③ **Statistical quantities**

The table below the phase error diagram gives an overview of the current frequency error, the phase error averaged over the current burst *(Phase Error RMS)*, the extreme value of the current phase error *(Phase Error Peak)* and the statistical distribution of these three quantities. The values in the three columns are calculated as follows:

- The *Current* column contains the frequency error, rms-averaged phase error and peak (max./min.) phase error for the current burst.
- The *Average* column contains the three quantities averaged over the last statistics cycle.
- The *Maximum* column contains the extreme values of the three quantities within all bursts measured.

Alternative Settings and Measurements

☞ chapter 4.

The measurement principle for phase and frequency errors is explained at the beginning of section *Modulation Measurement Menu.*

For configuration settings see section *Measurement Configurations (Modulation Menu).*

☞ chapter 4.

☞ chapter 3.

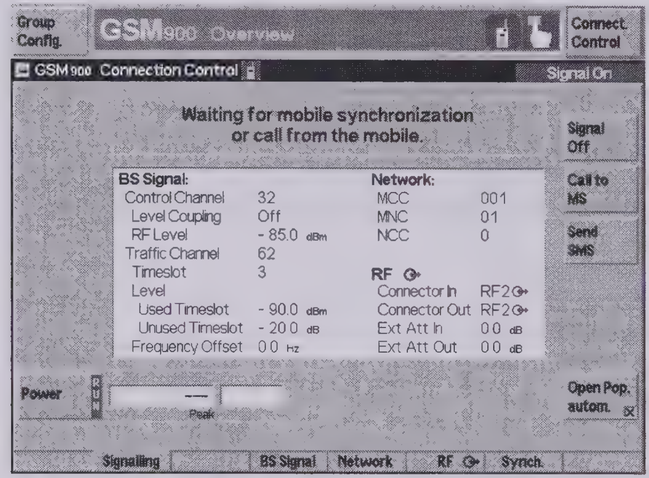
In this chapter a comprehensive description of measurement control and on the definition of statistical quantities is given.

Signalling Mode

In the *Signalling* mode the CMU first transmits a control channel signal to which the mobile is able to synchronize. A call can then be established from either the CMU or the mobile. The measurement must be synchronized to the signal transmitted by the mobile; an external trigger signal can not be used.

Call Setup and Signalling Parameters

The signalling processes and configurations are controlled via the *Connection Control* popup menu. A control channel signal is switched on and the second of four *Signalling* index cards contained in the *Connection Control* popup menu is automatically displayed when the *Signalling* Mode is selected (see *Menu Select* menu on page 2.4; for the following examples, *GSM 900-MS Signalling Meas.* with the *Overwiew* menu was selected, and another *RESET* was performed).


Group Config.
GSM900 Overview
Connect. Control
GSM900 Connection Control
Signal On
Signal Off
Call to MS
Send SMS
Power
Peak
Open Pop. autom.
Signalling
BS Signal
Network
RF
Synch.

Waiting for mobile synchronization or call from the mobile.

BS Signal:
Control Channel 32
Level Coupling Off
RF Level - 85.0 dBm
Traffic Channel 62
Timeslot 3
Level
Used Timeslot - 90.0 dBm
Unused Timeslot - 20.0 dB
Frequency Offset 0.0 Hz

Network:
MCC 001
MNC 01
NCC 0

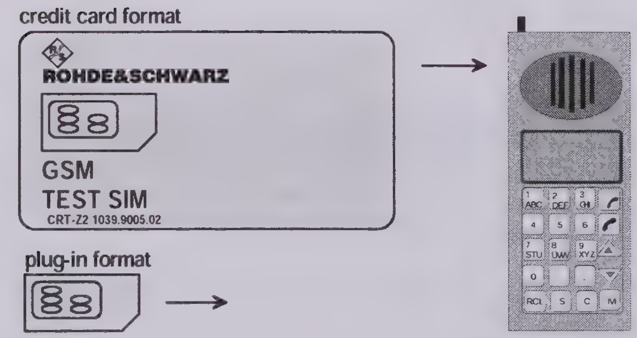
RF
Connector In RF2
Connector Out RF2
Ext Att In 0.0 dB
Ext Att Out 0.0 dB

Step 1

The *Signalling (Signal On)* index card indicates the most important parameters characterizing the signals generated by the CMU.①

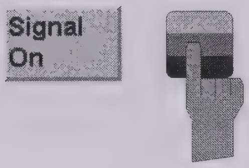
In addition the network identity and the characteristics of the input and output connectors are shown.②

Below the parameter list the *Power* softkey shows the current status of the power measurement, the current measured peak power and its ratio to the maximum input power set in the *Group Configuration* menu. At present, the power measurement is switched on, however, no signal is received because no call connection with the mobile phone has been established so far.


credit card format
ROHDE&SCHWARZ
GSM
TEST SIM
CRT-Z2 1039.9005.02
plug-in format
1
2 ABC
3 DEF
4 GHI
5
6
7 STU
8 UVW
9 XYZ
0
RCL
S
C
M

Step 2

- ➢ Insert a test SIM card of the appropriate size into the phone and switch on.④
- ➢ If requested, enter the PIN number followed by #.
  (PIN No. of Rohde & Schwarz test SIM card: 0000). ⑤
- ➢ Make sure that your mobile is connected to RF 2 (default input/output).



- ➢ Press the *Call to MS* softkey.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① BS Signal

The CMU is able to generate two different RF carrier signals (traffic channel and control channel) which can be configured separately. This allows a complete simulation of what happens in a real GSM network.

☞ chapter 4.

The control and traffic channels are configured in the *Network* index card of the Connection Control menu. To access this card press the associated hotkey.

② Network Identity, ⊸/Ext.Att.

The network is identified by the three code numbers MCC (mobile country code), MNC (mobile network code) and NCC (national color code). These codes are transmitted to the mobile station on the control channel. The CMU uses the default settings shown in the diagram on the left side.

Input/output connectors suitable for the type of measurements and signal levels must be chosen – see section *RF connection* on page 2.3. An external input/output attenuation value can be specified in order to compensate for known attenuations of the input/output signal like those caused by cables.

☞ chapter 4.

The network identity and other parameters characterizing the network are configured in the *Network* index card of the Connection Control menu. To access this card press the associated hotkey (see below).

Input/output connectors and external attenuations are configured in the *RF /*⊸ index card.

... on Step 2

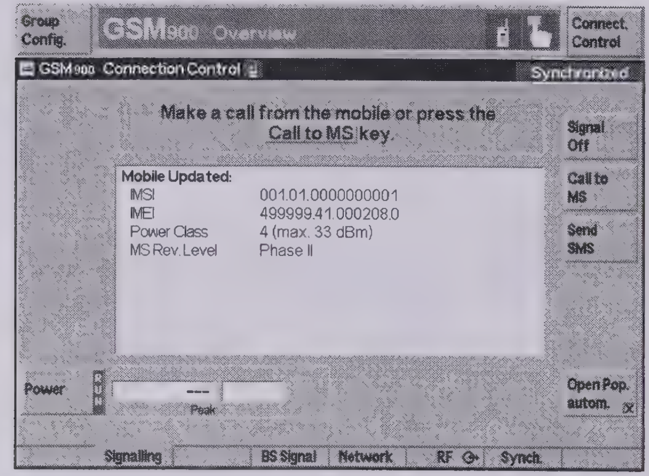
④ SIM card, test SIM

Two types of SIM card are specified for use in the GSM system, one the size of a credit card and the considerably smaller plug-in SIM of about 15 x 20 mm. One SIM card must be inserted in the mobile phone in order to set up a call. However, it is also possible to make an emergency call without any card by entering 112.

Most mobile phones require a so-called test SIM card in order to test the sensitivity (bit error rate and related quantities) in a test mode. A test SIM card is available from Rohde & Schwarz with the designation CRT-Z2 (id. no. 1039.9005.02). It features credit card size and can be easily converted to "plug-in" format.

⑤ Pin number

Use care when entering the PIN number as only three false tries are allowed before the card is automatically blocked. It can be unblocked by entering the PUK number which is either known or can be obtained from the company that issued the card. See also the appropriate section in the operating manual of your mobile phone.


Group Config.
GSM900 Overview
Connect. Control
GSM900 Connection Control
Synchronized
Signal Off
Call to MS
Send SMS
Power
Peak
Open Pop. autom.
Signalling
BS Signal
Network
RF
Synch.

Make a call from the mobile or press the Call to MS key.

Mobile Updated:
IMSI 001.01.0000000001
IMEI 499999.41.000208.0
Power Class 4 (max. 33 dBm)
MS Rev. Level Phase II

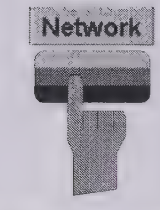
Step 3

A number of subsequent messages indicate that the mobile synchronizes to the CMU's control channel signal and performs a location update. The *Synchronized* card is displayed. ①

The *Signalling (Synchronized)* index card indicates the most important parameters characterizing the mobile phone.②

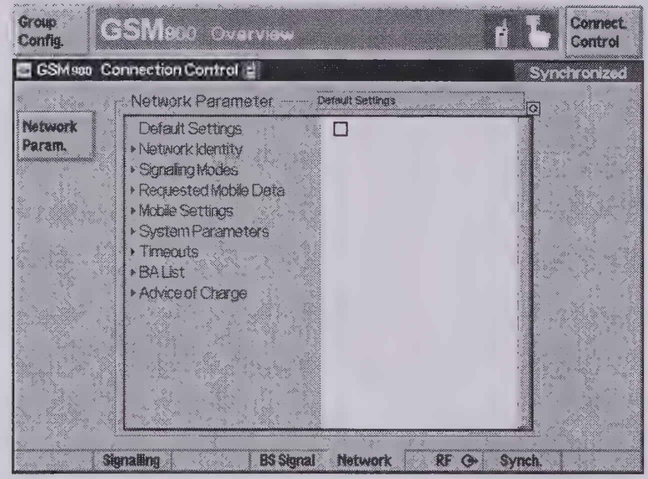
Display of the *Signalling* index cards may be suppressed using the *Open Pop. autom.* softkey.

Step 4



➢ Press the *Network* hotkey.

The *Network* index card is displayed.


Group Config.
GSM900 Overview
Connect. Control
GSM900 Connection Control
Synchronized
Network Param.
Network Parameter
Default Settings
Signalling
BS Signal
Network
RF
Synch.

Default Settings ☐
- Network Identity
- Signaling Modes
- Requested Mobile Data
- Mobile Settings
- System Parameters
- Timeouts
- BA List
- Advice of Charge

The *Network* index card defines a variety of parameters concerning the network and the operating mode of the mobile station.

The purpose of these settings is to simulate the operating conditions of a mobile station in the GSM network as realistically as possible. Many of the settings have a direct impact on the speed of the *Signalling* measurements. ③

Additional Information...

... on Step 3

① Location update

The information transmitted by the CMU on the control channel requests the mobile phone to perform a location update procedure after switching-on. This is similar to a registration procedure in analog networks and serves to inform the base station that a certain mobile has been switched on now and is available for calls.

If the mobile phone has already performed a location update when a call is set up, the *Synchronized* signalling state is skipped and the *Call Established* state is reached directly.

② Mobile Updated

The *Mobile Updated* list shows the basic properties of the connected mobile station which are transmitted to the CMU.

- The *international mobile subscriber identity (IMSI)* consists of the 3-digit mobile country code, the 2-digit mobile network code and the 10-digit mobile subscriber id. no.
- The *international mobile station equipment identity (IMEI)* consists of the 6-digit type approval code, the 2-digit final assembly code, the 6-digit serial no. and the 1 or 2-digit software version no.

The following hardware-related parameters determine the maximum output power of the mobile station:

- Power class (1 to 5)
- MS revision level (phase I or II)

... on Step 4

③ Network parameters

The purpose of network parameter settings in the mobile test can be rather different from the original purpose (in the real GSM network). We illustrate this with two examples:

The *BA list (base station allocation list)* informs the mobile about the channels available in a given area. The mobile uses the BA list to determine to which RF channel it will receive the next handover request. The CMU uses the *BA list* to test a mobile when the synthesizer is jumping continuously from channel to channel and the software has to organize this, to evaluate and report the results.

In the *DTX (discontinuous transmission)* mode the mobile transmits traffic channel frames only when there is voice or data to be transmitted. This mode is used mainly in order to save mobile battery power. In the test mode, a DC current measurement during DTX will provide information about a possible leaking component of the mobile.

Alternative Settings and Measurements

☞ chapter 4.

The *Location Update* parameter in the *Network* index card determines in which cases a location update is performed.

☞ chapter 4.

A comprehensive list of mobile station properties is displayed in the *Call Established* signalling state.

Power classes and GSM revision levels are listed with their maximum output power in section *Limits for the Average Burst Power* in chapter 4.

☞ chapter 4.

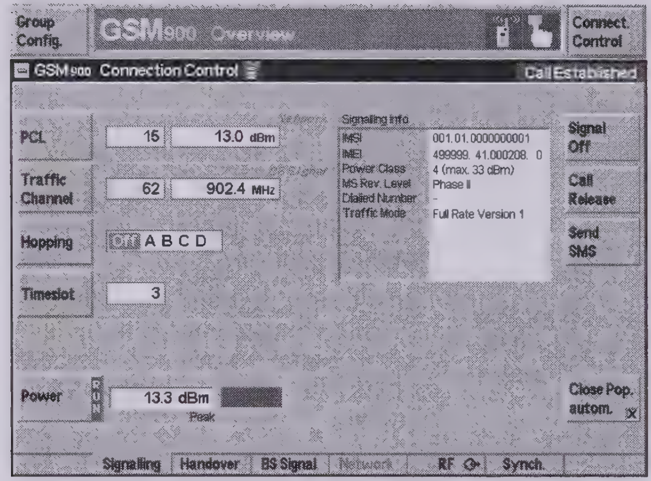
Signalling

Step 5

- ➢ Press the *Signalling* hotkey.

The *Signalling (Synchronized)* index card is displayed again.

- ➢ Press the *Call to MS* softkey to set up a call to the mobile station.
- ➢ As soon as it starts ringing, pick up your phone.
- ➢ Press *Connect. Control.*


Group Config.
GSM900 Overview
Connect. Control
GSM900 Connection Control
Call Established
Network
BS Signal
Signal Off
Call Release
Send SMS
Close Pop. autom.
X
RUN
Signalling
Handover
BS Signal
Network
RF
Synch.

PCL 15 13.0 dBm

Traffic Channel 62 902.4 MHz

Hopping Off A B C D

Timeslot 3

Power 13.3 dBm Peak

Signaling info

IMSI	001.01.0000000001
IMEI	499999. 41.000208. 0
Power Class	4 (max. 33 dBm)
MS Rev. Level	Phase II
Dialed Number	-
Traffic Mode	Full Rate Version 1

The *Signalling (Call Established)* presents a comprehensive list of the signalling parameters (see *Mobile Updated* on page 2.17).

Besides the power control level of the mobile station ① and the parameters of the traffic channel signals transmitted by the CMU ② can be configured.

- ➢ Press the *Escape* key to close the *Connection Control* menu and return to the *Overview* menu.

Additional Information...

Alternative Settings and Measurements

... on Step 5

① Power control level (PCL)

Dynamic power control is used in GSM networks to reduce the output power of the mobile station as far as possible. In practice the base station sets the mobile power on a dimensionless scale of *power control levels (PCL)* ranging from 0 to 31. In GSM900, PCL 0 corresponds to the largest nominal output power (39 dBm), power control levels between 16 and 31 can be set for phase II mobiles only.

In contrast to the PCL the *power class* characterizes the nominal maximum output power of the mobile. Depending on the power class of the mobile the range of possible PCL settings may be restricted.

☞ chapter 4.

PCL levels and power classes are listed in section *Limits for the Average Burst Power* in chapter 4.

② Traffic channel

The channel number of the BS traffic channel signal is defined according to GSM specifications as explained for the *Non Signalling* mode (downlink, see *Analyzer/Generator menu* on page 2.7).

The traffic channel can be fixed or changed periodically (frequency hopping). Frequency hopping is defined by means of one of the four hopping sequences A, B, C, D.

With the CMU basic unit timeslots 2 to 6 may be selected for the traffic channel because the timeslots 0, 1, and 7 are occupied by the BCCH and for reconfiguring.

☞ chapter 4.

Besides the four GSM standard hopping sequences A to D arbitrary sequences consisting of up to 64 channel numbers may be defined and used.

Out-of-tolerance power measurements

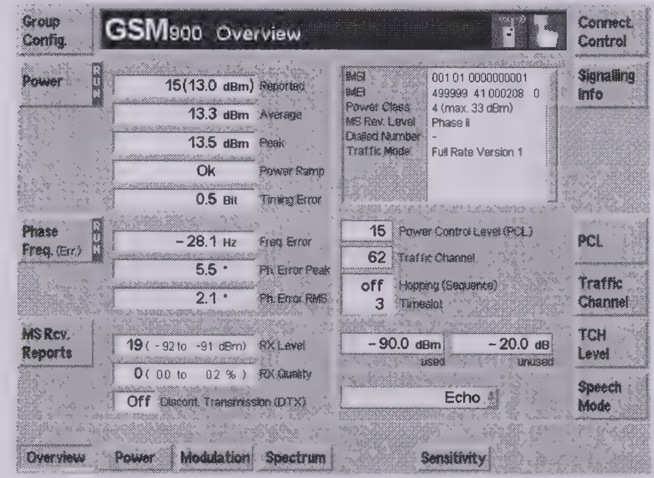
If a power measurement is out of tolerance, please ensure that the attenuation of any cables and/or antenna couplers used is being taken into account by the CMU. As some GSM power levels must be within ±2 dB of the nominal value given in the specifications, even a small attenuation can result in an out-of-tolerance measurement.

External attenuation values for each input/output may be entered in the *RF* ↔ index card of the *Connect. Control* menu

The cables, RF connections and antenna couplers must also be in good condition for satisfactory measurements. Dirty or broken RF connections can cause problems at the high frequencies used by GSM networks.

Receiver Reports and Power Measurements

Besides the signalling parameters discussed above the receiver reports of the mobile station are transmitted to the CMU. Power and modulation measurements can be performed as in the *Non Signalling* mode.


Group Config.
GSM900 Overview
Connect. Control
Power
Signalling Info
Phase Freq. (Err.)
PCL
Traffic Channel
MS Rcv. Reports
TCH Level
Speech Mode
Overview
Power
Modulation
Spectrum
Sensitivity

15(13.0 dBm) Reported
13.3 dBm Average
13.5 dBm Peak
Ok Power Ramp
0.5 Bit Timing Error
−28.1 Hz Freq. Error
5.5 ° Ph. Error Peak
2.1 ° Ph. Error RMS
19 (−92 to −91 dBm) RX Level
0 (0.0 to 0.2 %) RX Quality
Off Discont. Transmission (DTX)

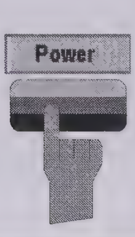
IMSI 001 01 0000000001
IMEI 499999 41 000208 0
Power Class 4 (max. 33 dBm)
MS Rev. Level Phase II
Dialled Number -
Traffic Mode Full Rate Version 1

15 Power Control Level (PCL)
62 Traffic Channel
off Hopping (Sequence)
3 Timeslot
−90.0 dBm used
−20.0 dB unused
Echo

Step 1

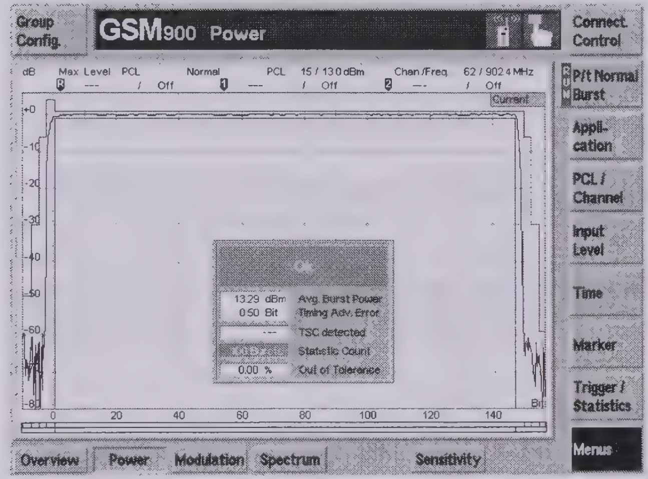
The *Overview* menu indicates the most important settings in the function group *GSM900-MS Signalling* and the main results of the *Power vs Time* and *Modulation* measurements. Moreover the receiver reports of the mobile station are displayed. ①

Power and modulation measurements can be performed in close analogy to the measurement of GSM signals in the *Non Signalling* mode. The differences between the two modes are related to the settings which can be made at the mobile station.



Step 2

- ➢ Press the *Power* hotkey to switch over to the graphical menu *Power vs Time.*

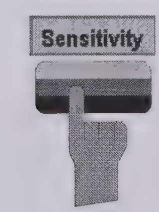

Group Config.
GSM900 Power
Connect. Control
P/t Normal Burst
Appli-cation
PCL / Channel
Input Level
Time
Marker
Trigger / Statistics
Menus
Current
+0
-10
-20
-30
-40
-50
-60
-80
0
20
40
60
80
100
120
140
Bit
Ok
Overview
Power
Modulation
Spectrum
Sensitivity

dB Max. Level PCL / Off Normal PCL --- / Off PCL 15 / 13.0 dBm Chan./Freq. 62 / 902.4 MHz --- / Off

13.29 dBm Avg. Burst Power
0.50 Bit Timing Adv. Error
--- TSC detected
Statistic Count
0.00 % Out of Tolerance

The *Power vs Time* menu shows the power of the current burst as a function of time. Compared to the *Non Signalling* mode the menu contains an additional softkey *Application.* The *Frequency* softkey is replaced by the *PCL/Channel* softkey

- ➢ Press the *Application* softkey to change the hotkeys displayed below the diagram.②
- ➢ Press the *P/PCL* hotkey to measure the average burst power as a function of the mobile's power control level.
- ➢ Press the *PCL Channel* softkey to check the PCL and traffic channel number set.③


Sensitivity

Step 3

- ➢ Press the *Sensitivity* hotkey to switch over to the *Sensitivity* menu.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① MS Receiver Reports

GSM mobile phones continuously measure the signal strength and quality of several nearby base stations. The measured values for the active base station (serving cell BTS) are regularly sent to the CMU in the so-called measurement reports.

The received signal input level (RX Level) is expressed in terms of dimensionless power levels ranging from 0 to 63. These levels depend linearly on the absolute signal levels measured in dBm. A high power level implies a high received signal input level.

The received signal quality (RX Quality) is expressed in terms of dimensionless quality levels (actually "error levels") ranging from 0 to 7. The quality levels depend linearly on the logarithm of the bit error rate. A high quality level implies a high bit error rate and thus a poor received signal quality.

☞ chapter 4.

The exact definition of RX Level and RX Quality is given in section *Panel MS Rcv. Reports – Received Results of the Mobile Phone.*

The dependence of RX Level and RX Quality on the CMU's output level can be quickly checked by varying the *TCH Level* in the used timeslot.

Different TCH levels can be set in the used timeslot and in the unused timeslots. This is useful for some tests specified by GSM.

... on Step 2

② P/PCL Measurement

The *P/PCL* measurement forms the second application in the measurement group *Power*. In this application, the average burst power of the mobile can be measured over the whole range of power control levels and for up to three different channels at once. The PCLs and channels to be measured can be selected; the total measurement time is below 3 s.

☞ chapter 4.

The two „applications" *Power* and *P/PCL* split up the measurement group *Power* in two subgroups. Measurement control, statistics settings and the display of measured values is independent of the selected application.

For a general discussion of measurement control and applications see chapters 3 and 5.

③ PCL/Channel and Trigger

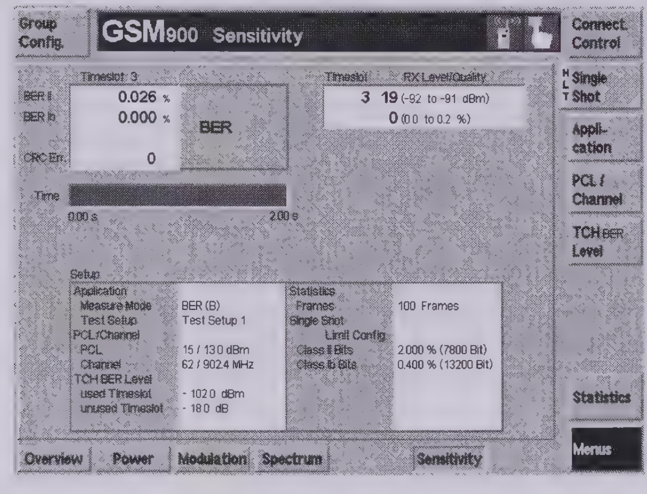
The PCL set for the mobile station and the traffic channel number can be checked and modified, if required, in the *Power vs Time* menu. This is in contrast to the *Non Signalling* mode where no settings concerning the device under test can be made.

Finally the two modes differ in the trigger modes available: In the *Non Signalling* mode an external trigger signal may be used whereas in the *Signalling* mode the measurements must be triggered by the input signal *(Free Run* or *Power* mode).

☞ chapter 4.

Sensitivity Measurements

Sensitivity measurements evaluate parameters which characterize the quality of transmission on the complete transmission path between CMU and mobile station. To this purpose the bits sent to the mobile station are looped back and retransmitted. The CMU compares the bits received with those sent and can thus calculate the percentage of faulty bits. Most but not all mobiles require a test SIM card to enter the loop-back mode (see *SIM card*, test SIM on page 2.15).


Group Config.
GSM900 Sensitivity
Connect. Control
Single Shot
Appli-cation
PCL / Channel
TCH BER Level
Statistics
Menus
Overview
Power
Modulation
Spectrum
Sensitivity
BER
Time
0.00 s
2.00 s

Timeslot: 3
BER II 0.026 %
BER Ib 0.000 %
CRC Err. 0

Timeslot RX Level/Quality
3 19 (-92 to -91 dBm)
0 (0.0 to 0.2 %)

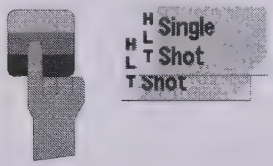
Setup
Application
Measure Mode BER (B)
Test Setup Test Setup 1
PCL/Channel
PCL 15 / 13.0 dBm
Channel 62 / 902.4 MHz
TCH BER Level
used Timeslot - 102.0 dBm
unused Timeslot - 18.0 dB

Statistics
Frames 100 Frames
Single Shot
Limit Config
Class II Bits 2.000 % (7800 Bit)
Class Ib Bits 0.400 % (13200 Bit)

Step 1

The *Sensitivity* menu controls the sensitivity tests and displays the measurement results together with the *RX Level* and *RX Quality* of the serving cell. This facilitates a comparison between the results reported by the mobile (RX Quality) and the sensitivity test results.

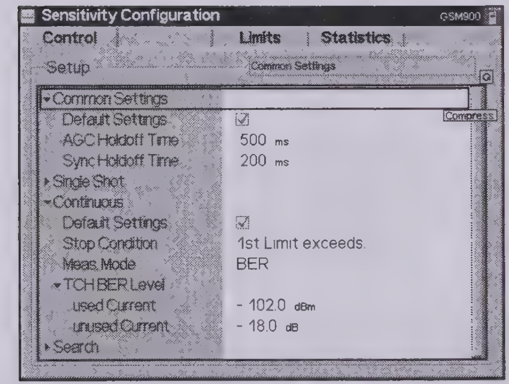
- ➢ Press the *Application* softkey to display all applications of the *Sensitivity* measurement group. ①
- ➢ Press the *Meas. Mode* hotkey and select *Burst by Burst.* ②


H L T Single Shot
H L T Shot

Step 2

- ➢ Press the *Single Shot* softkey twice.

The *Sensitivity Configuration* menu is opened.


Sensitivity Configuration
GSM900
Control
Limits
Statistics
Compress

Setup Common Settings
- Common Settings
  - Default Settings ☑
  - AGC Holdoff Time 500 ms
  - Sync Holdoff Time 200 ms
- Single Shot
- Continuous
  - Default Settings ☑
  - Stop Condition 1st Limit exceeds.
  - Meas. Mode BER
  - TCH BER Level
    - used Current - 102.0 dBm
    - unused Current - 18.0 dB
- Search

The *Control* index card contains the parameters configuring the sensitivity measurement. Most parameters are equal or analogous to the ones used in *Power vs Time* or *Modulation* measurements. Major differences occur in the measurement modes available (*Control* index card, ②) and in the definition of the statistics count (Statistics index card). ③

Additional Information...

Alternative Settings and Measurements

... on Step 1

① Applications

Within the *Sensitivity* measurement group, the repetition modes *Single Shot* and *Continuous* are treated as different applications. For single shot measurements, up to ten different test setups with independent parameters can be configured (see *Control* index card in the *Sensitivity Configuration* menu).

☞ chapter 4.

For a general discussion of measurement control and applications see chapters 3 and 5.

② Measurement Mode

A number of different quantities characterizing the quality of transmission are defined:

- Bit error rate (for class II and class Ib bits)
- Residual bit error rate (for class II and class Ib bits)
- Frame erasure rate

The type of quantities measured depends on the measurement mode *(BER, RBER/FER*, or *Burst by Burst)*. In the *Burst by Burst* mode which is specified for GSM phase II and phase II+ mobiles, only bits without error protection are transmitted. This enhances the speed of the bit error rate test (fast BER test).

☞ chapter 4.

The bit classes and measured quantities are explained at the beginning of section *Measurement Menu Sensitivity.*

... on Step 2

③ Statistics

In the framework of sensitivity tests the basic evaluation period is equal to the frames used by the speech coder and consisting of 260 bits. Bursts and TDMA frames are irrelevant.

A statistics cycle thus consists of a definite number of frames.

☞ chapter 3 and 4.

Failed Sensitivity Test

If a BER test fails check the following:

1. Ensure that the attenuation of any antenna coupler and/or cables used is being taken into account by the CMU. During the test the mobile receiver is being tested with very low RF signal levels, and even a small attenuation can cause the CMU to show a fail indication.
2. An external signal from a real network may interfere with the signal sent from the CMU to the mobile, in particular during BER tests where the output level of the CMU is reduced to as low as -104 dBm. The BER test should ideally be performed in a shielded room, however, if this is not possible, the channel(s) used for the test should be changed. If different results are obtained on neighboring channels, the problem is likely to be due to external interferences.

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3 Manual Control

This chapter gives a brief survey of the operating concept and structure of the user interface for GSM mobile phone tests. The CMU was designed for maximum operating convenience and flexibility. All instrument functions are grouped together in menus, each of them provides a number of related configuration settings or displays a group of measured quantities. All menus show a similar structure so that many settings, once defined, can be used in several menu groups. Switchover between the different menu groups and signalling modes is possible at any time.

In the following, the different measurement modes and measured quantities are discussed. Settings and measurement parameters frequently encountered are explained from a general point of view.

The formal aspects of measurement control are discussed in more detail in chapter 5 *(Remote Control – Basics)*. For a presentation of the CMU's control elements, menu types and dialog elements within the menus refer to chapter 3 of the operating manual for the CMU basic unit.

Menu Structure

The menus used to control GSM measurements can be arranged in different ways. According to their tasks, they form the following groups:

- The function groups *GSM900-MS, GSM1800-MS* and *GSM1900-MS*,
- The two signalling modes *Signalling* and *Non Signalling*,
- General configurations *(Group Configuration, Connection Control)*, configurations specific to a measured quantity *(Power vs Time Configuration, Modulation Configuration, Spectrum Configuration, Sensitivity Configuration)*, and menus displaying the results of the measurement *(Analyzer/Generator, Overview, Power (vs Time), Modulation, Spectrum (due to Modulation* and *due to Switching), Sensitivity)*.

In a more formal sense, the CMU uses main menus, popup menus, graphical measurement menus and dialog windows of various size. This aspect is discussed in chapter 3 of the operating manual for the CMU basic unit.

Signalling Modes

GSM measurements are performed in one of the two modes *Signalling* or *Non Signalling.*

Definition

The term signalling denotes all actions necessary to establish, control and terminate a communication between the base station and the mobile phone. The signalling messages conveyed allow the mobile station and the network to discuss the management of issues either related to the user or concerning technical aspects of the communication.

Non Signalling Mode

In the *Non Signalling* mode, the CMU generates an RF signal conforming to GSM specifications and analyzes the signal with GSM characteristics (i.e. with definite level in the designated channel and in the adjacent channels, definite phase and frequency, and bit content) retransmitted by the device under test. No signalling parameters are transferred so that test times can be reduced considerably.

The *Non Signalling* mode is typically used for module tests or test of mobiles in a special "test mode". Normal burst signals are generated and analyzed. Transmitter quality measurements (burst power versus time, modulation parameters (phase and frequency errors), adjacent channel power) can be performed for normal bursts. The measurement may be triggered by an additional external signal.

Signalling Mode

In the *Signalling* mode, the CMU starts to transmit a signal using a control channel. In subsequent steps, the mobile synchronizes to the control channel, decodes the information transmitted, and performs a location update so that a call can be delivered from either the mobile or the CMU.

The signaling mode serves to measure the mobile phone performance under realistic operating conditions where the CMU mimics an GSM base transceiver station. The CMU is able to configure a broad range of network parameters and to determine the parameters characterizing the mobile. Measurements of the burst power versus time, of the modulation parameters (phase and frequency errors), the adjacent channel power, and of the bit error rate can be performed for normal bursts.

Symbols for Signalling Mode and State

The *signalling mode* and *state* is indicated to the left of the operating mode in each main menu and graphical measurement menu (see chapter 3 of CMU200 operating manual). The following symbols occur in function group *GSM900/1800/1900-MS*:

📱	Non signalling mode
📱	Signalling mode, Signal Off
📱	Signalling mode, Signal On
📱	Signalling mode, Synchronized
📱	Signalling mode, Call Established

Configurations

The CMU offers a wide range of settings for input and output signals, signalling parameters and measurements. Configurations either refer to the whole function group *(Group Configuration, Connection Control)* or to a particular measurement.

Group Configuration

The *Group Config.* softkey is located on the left side of the title bar of each main and graphical measurement menu. It opens a popup menu with several tabs configuring

- the receiver attenuator (input level),
- the trigger condition.

All settings made in the *Group Config.* menu apply to the whole function group. They can be overwritten, if this is required for a particular measurement, by means of the softkeys and hotkeys offered in the graphical measurement menus.

Connection Control

The *Connect. Control* softkey is located on the right side of the title bar of each main and graphical measurement menu. It opens a popup menu with several tabs configuring

- the signals generated and analyzed by the instrument,
- the RF connectors to be used and the external attenuation,
- the reference signal.

All settings made in the *Connect. Control* menu apply to the whole function group.

Configurations of measurements

A popup menu offering specific settings is assigned to each measurement group *(Power vs. Time, Modulation, Spectrum, and Sensitivity).* The following parameters can be defined:

- The repetition mode and stop condition for the measurement
- tolerances for the measured quantities,
- statistic count and display mode.

These settings are explained in more detail below (see section *General Settings* on page 3.5).

Measurement Groups

Measurement results are indicated in two different ways:

- Discrete values and parameters are displayed in output fields, lists and tables. In remote control, these results are referred to as scalars.
- Traces are displayed in a Cartesian coordinate system, the time forming the x-axis scale. Relatively small sets of test points are generally viewed in a bargraph chart. In remote control, results of this type are referred to as arrays.

While the measurement is running in repetition mode *continuous* (see page 3.5), the indicated results are constantly updated. As shown in the table below, the measurement groups depend on the signalling mode.

Table 3-1Measurement Groups in the Signalling and Non Signalling Mode

Non Signalling	**Signalling**
Analyzer/Generator Shows the settings for the signals generated and analyzed by the instrument and presents an overview of the basic scalar power and modulation results.	**Overview** Shows the settings for the traffic channel and speech mode and presents an overview of the basic scalar power and modulation results. The receiver parameters and various signalling parameters reported by the mobile station are indicated in addition.
Power vs Time Shows the trace of the measured burst power as a function of time. The peak power, statistical results and the results of the limit check are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line).	**Power** Shows the trace of the measured burst power as a function of time. The peak power, statistical results and the results of the limit check are indicated as well. In addition, the average burst power can be measured as a function of the PCL of the mobile phone. Single points of the trace may be evaluated by means of graphical tools (markers, D-Line).
Modulation Shows the phase error of the transmitted burst as a function of time. The frequency error, average and RMS phase error, statistical results and the results of the limit check are indicated in addition.	**Modulation** Shows the phase error of the transmitted burst as a function of time. The frequency error, average and RMS phase error, statistical results and the results of the limit check are indicated in addition.
Spectrum Shows the amount of energy that spills outside the designated channel. The off-channel spectrum is caused by the modulation (spectrum due to modulation) and to the bursty nature of the RF signal (spectrum due to switching). Statistical results and the results of the limit check are indicated in addition.	**Spectrum** Shows the amount of energy that spills outside the designated channel. The off-channel spectrum is caused by the modulation (spectrum due to modulation) and to the bursty nature of the RF signal (spectrum due to switching). Statistical results and the results of the limit check are indicated in addition.
–	**Sensitivity** Shows the results of the bit error rate test and the receiver parameters reported by the mobile station.

General Settings

A number of settings can be made in several of the configuration menus assigned to the measurement groups *Power vs. Time, Modulation, Spectrum,* and *Sensitivity*. In combination, these settings define the scope of the measurement, i.e. the number of bursts measured and the results displayed. The following brief overview is intended to avoid confusion of terms.

Application

Applications represent different measurements belonging to the same measurement group. They effectively split up a measurement group into various related subgroups which can be configured separately.

They are selected via the *Application* softkey in the graphical measurement menus.

Statistic Count / Statistics Cycle

The *statistic count* is set in the *Statistics* tab of the configuration popup-menus assigned to each measurement group.

The statistic count is equal to the integer number of evaluation periods which form one statistics cycle. An evaluation period corresponds to the duration of a burst (measurement groups *Power vs. Time, Modulation, and Spectrum)* or a frame (measurement group *Sensitivity).* Together with the *stop condition,* the *repetition mode* determines when exactly the measurement is stopped.

Repetition Mode

The *repetition mode* is set in the *Control* tab of the configuration popup-menus assigned to the three measurement groups *Power vs. Time, Modulation,* and *Spectrum.* In the *Sensitivity* menu, the repetition mode can be set via the *Application* softkey.

The *repetition mode* defines how many statistics cycles are measured if the measurement is not stopped by a limit failure (see stop condition *On Limit Failure* below). Two modes are available for all measurements:

Single Shot	The measurement is stopped after one statistics cycle
Continuous	The measurement is continued until explicitly terminated by the user

A third repetition mode is available with remote control:

Counting	Repeated single shot measurement with a fixed number of statistic counts

Stop Condition

The *stop condition* is set in the *Control* tab of the configuration popup-menus assigned to the each measurement group.

For *Power vs. Time* and *Modulation* measurements, two stop conditions can be selected:

None	The measurement is performed according to its repetition mode, regardless of the measurement results,
On Limit Failure	The measurement is stopped as soon as one of the limits is exceeded, regardless of the repetition mode set. If no limit failure occurs, it is performed according to its repetition mode.

For *Sensitivity* measurements, the stop condition *None* (see above) and two further conditions can be selected:

1st Limit exceed.	The measurement is stopped as soon as one of the limits is exceeded
All Limits exceed.	The measurement is stopped as soon as all limits defined are exceeded. Again, if no limit failure occurs, it is performed according to its repetition mode.

Display Mode

The *display mode* is set in the *Statistics* tab of the configuration popup-menus assigned to the two measurement groups *Power vs. Time* and *Modulation.*

It defines the trace displayed in the measurement diagram showing either the burst power or the phase error as a function of time. In general, traces are calculated from a set of test points with fixed abscissa values t_i. These values t_i are equidistantly distributed along the time axis. Their spacing is equal to 1/4 bit so that the trace comprises a maximum of i_{max} = 669 test points (in the case of power measurements for normal bursts; the range for modulation measurements is shorter).

The display mode defines how the displayed trace is calculated if the measurement extends over several bursts.

Current	The current burst is displayed.
Minimum	At each test point t_i, the minimum value of all bursts measured is displayed.
Maximum	At each test point t_i, the maximum value of all bursts measured is displayed.
Minimum/ Maximum	At each test point t_i, the extreme value of all bursts measured is displayed, i.e. the maximum or minimum, whichever has a larger absolute value.
Average	At each test point t_i, the arithmetic mean value of the last c bursts measured is displayed where c is the number of bursts forming one statistic count (the statistics window is continuously shifted). While the measurement time is (still) less than one statistic count the arithmetic mean value of all bursts measured is displayed.

Note the difference in the calculation of *Average* on one hand, *Minimum, Maximum* and *Minimum/Maximum* on the other hand, if the measurement extends over more than one statistic count (repetition mode *Continuous,* measurement time longer than one statistic count).

The burst power is represented in a semi-logarithmic diagram. This implies that the average must be calculated before logarithmation.

Calculation of statistical quantities

In *Power vs. Time* and *Modulation* measurements the statistical functions *Average, Minimum, Maximum* and *Minimum/Maximum* are applied to a set of test points depending on two independent parameters:

- the time, i.e. the abscissa values t_i, i ranging from 1 to i_{max} (see above).
- the burst number ranging from 1 to the number of the current burst.

In general the result of a statistical operation depends on the parameter range considered and – in the case of statistics functions evaluated over several parameters – on the order of evaluations. This is why the definition of statistical quantities deserves some attention. We point out some particular examples:

1. In the *Power vs Time* menu, the quantity *Average Burst Power* denotes the average power of the current burst. i.e. the arithmetical mean value of all test points t_i located in the useful part of the burst (lower area 1 in the power template in chapter 4).
2. In the *Modulation* menu the quantities *Frequency Error, Phase Error RMS* and *Phase Error Peak* are first calculated for the current burst and entered in the *Current* column of the output table. The results in the *Minimum/Maximum* (*Average)* column correspond to the extreme value (the RMS value) of the *Current* results calculated over all bursts measured (over the last c bursts measured where c is the number of bursts forming one statistics cycle).

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4 Functions and their Application

This chapter explains in detail all functions for the measurement of mobile stations supporting the GSM standard.

The chapter is divided in two sections corresponding to the two function groups for module tests *(GSM900/1800/1900-MS Non Signalling)* and for mobile tests including signaling *(GSM900/1800/1900-MS Signalling*). Within the two sections, the discussion is structured according to the provided measurements and configurations (see graphical overview at the end of chapter 3). In contrast to chapter 6, *Remote Control – Commands,* general measurement configurations are relegated to the end of each section.

The description of each softkey, select or input field is followed by the corresponding remote-control commands. Similarly, the description of the commands in chapter 6 also contains the corresponding menus of the user surface.

Each menu and each panel is briefly described first and then illustrated together with its call button. The menu functions are explained according to the following principle:

Softkey

Short function definition

Designation of select/input field

Definition of field function.

Further description of the field: purpose, interaction with other settings, notes...

Parameter 1	Description of parameter 1
Parameter 2	Description of parameter 2

...

Further description of the parameters: purpose, interaction with other settings, notes...

Remote control

```
Remote-control command (long form)  Parameter1 | Parameter2
...
```

For all numerical values, including their ranges and default settings, please refer to the description of the remote-control commands in chapter 6.

The description of the operating concept is to be found in chapter 3 of the operating manual for the CMU basic instrument; besides, a description of measurement control and the essential settings and an overview of the most important menus is given at the end of chapter 3 in the present GSM manual. A comprehensive index listing important keywords and the proper names of all menus, dialog elements and softkeys is appended to the end of this manual.

GSM Measurements without Signalling (Non Signalling)

The structure of this section is based on the configuration and measurement groups defined in the function group *GSM900/1800/1900-MS Non Signalling*, i.e. the menus of the graphical user surface. The menus will be dealt with in their order of operation:

1. Global settings *(Analyzer/Generator)* and display of generator signals
2. Measurement menus *(Power vs Time* and *Modulation):* performance of the measurements, output of measurement results, specific measurement configurations
3. Global configurations *(Group Configuration, Connection Control)*

Measurement Menu Analyzer/Generator

The main menu *Analyzer/Generator* configures the attenuators on the transmitter and receiver side, i.e. the signals of the RF generator and the signals received and analyzed by the CMU. At the same time, it displays the current values of important power and modulation parameters of the received signal.

With respect to layout and function, the three panels for signal configuration are identical with the panels that constitute the popup menu *Signal* in the menu group *Connection Control*:

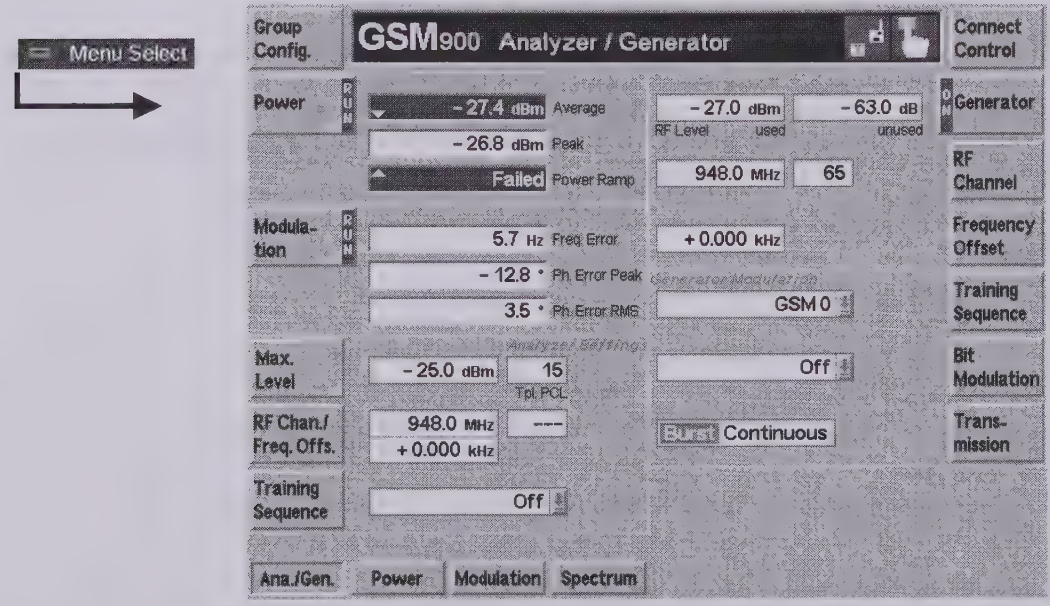
Panel Analyzer Settings	Analyzer control	See page 4.38
RF Generator	Generator control	See page 4.40
Generator Modulation	Generator modulation	See page 4.42

Two further panels indicate characteristic parameters of the signal received by the CMU (average values, extreme values, matching of tolerances):

Panel Power	Results of power measurement
Panel Modulation	Results of modulation measurement (phase and frequency errors)

The behavior of these parameters as a function of time can be displayed in the measurement groups *Power vs Time* and *Modulation*.

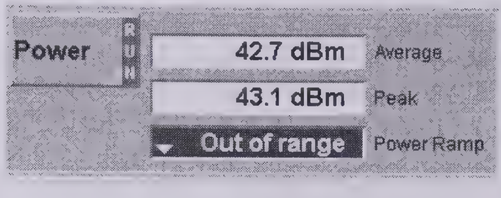
The main menu *Analyzer/Generator* is opened from the main menu *Menu Select* (with associated key at the front of instrument). It is linked with the remaining measurement menus of the function group *GSM900/1800/1900-MS Non Signalling Mode* via the hotkeys.


Menu Select
Group Config.
GSM900 Analyzer / Generator
Connect Control
Power
RUN
Modulation
RUN
Max. Level
RF Chan./ Freq. Offs.
Training Sequence
Generator
ON
RF Channel
Frequency Offset
Training Sequence
Bit Modulation
Transmission
Analyzer Setting
Generator Modulation
Burst
Ana./Gen.
Power
Modulation
Spectrum

-27.4 dBm Average
-26.8 dBm Peak
Failed Power Ramp
5.7 Hz Freq. Error
-12.8 ° Ph. Error Peak
3.5 ° Ph. Error RMS
-25.0 dBm 15 Tpl. PCL
948.0 MHz ---
+0.000 kHz
Off
-27.0 dBm RF Level used -63.0 dB unused
948.0 MHz 65
+0.000 kHz
GSM 0
Off
Continuous

Fig. 4-1 Measurement menu Analyzer / Generator

Power Panel



Power RUN

42.7 dBm Average

43.1 dBm Peak

Out of range Power Ramp

The panel *Power* contains three output fields indicating the average power, the peak power and matching of the tolerances *(Power vs Time)* for the signals measured. These results are also indicated in the info box in the graphical measurement menu *Power vs. Time* (page 4.5).

Power	The *Power* softkey indicates the status of the power measurement *(RUN / HLT / OFF).* This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status of the measurement is unaffected upon switchover to other menus controlling a *Power* measurement, however, a running measurement is restarted.
Measurement configuration	Pressing the *Power* softkey twice opens the popup menus *Power vs Time Configuration* (see page 4.12).

Remote control

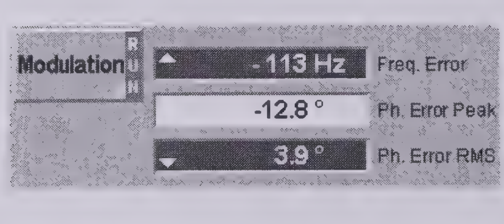
```
INITiate:POWer
ABORt:POWer
STOP:POWer
CONTINUE:POWer
```

Average	Average power of the current burst in dBm. The result does not depend on the measurement mode (single shot or continuous measurement).
Peak	Peak power of the current burst in dBm. As no comparison is made between different bursts the result does not depend on the repetition mode (single shot or continuous measurement).
Power Ramp	Matching of the tolerances by the current burst. The messages that may appear in the list field are self-explanatory.

Remote control

```
READ[:SCALar]:POWer[:RESult]
FETCh[:SCALar]:POWer[:RESult]?
SAMPle[:SCALar]:POWer[:RESult]?     Response: <Result>
```

Modulation Panel



Modulation RUN

- 113 Hz Freq. Error

-12.8 ° Ph. Error Peak

3.9 ° Ph. Error RMS

The *Modulation* panel contains three output fields indicating the current frequency error *(Frequ. Error),* the maximum phase error *(Ph. Error Peak)* and RMS phase errors averaged over a burst *(Ph. Error RMS)* of the measured signal. These values are also indicated in the graphical measurement menu *modulation* (see page 4.18).

Modulation	The *Modulation* softkey indicates the status of the modulation measurement *(RUN / HLT / OFF).* This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status of the measurement is unaffected upon switchover to other menus controlling a *Modulation* measurement, however, a running measurement is restarted.

Measurement configuration Pressing the *Modulation* softkey twice opens the popup menu *Modulation Configuration* (see page 4.22).

Remote control

```
INITiate:MODulation
ABORt:MODulation
STOP:MODulation
CONTINUE:MODulation
```

Freq. Error Frequency error of the current burst in Hz. As no comparison is made between different bursts the result does not depend on the repetition mode (single shot or continuous measurement).

Ph. Error Peak Extreme value of the phase error of the current burst in degrees. The result can thus be positive or negative and does not depend on the measurement mode (single shot or continuous measurement).

Ph. Error RMS RMS phase error of the current burst in degrees.

Remote control

```
READ[:SCALar]:MODulation[:RESult]
FETCh[:SCALar]:MODulation[:RESult]?
SAMPle[:SCALar]:MODulation[:RESult]?        <Result>
```

Power vs Time Measurements

The menu group *Power vs Time* comprises the functions for measuring the RF power of the received burst signal as a function of time. The measurement results are displayed in the graphical measurement menu *Power vs Time,* the popup menu *Power vs Time Configuration* is used for configuration of the measurements.

Measurement Menu (Power vs Time)

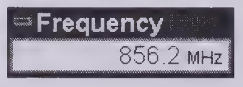
The graphical measurement menu *Power vs Time* shows the results of the burst analysis (power measurement).

- The main softkey *Power vs Time* indicates the status of the power measurement *(RUN | HLT | OFF)* and opens the configuration menu *Power vs Time Config*.
- The other softkeys to the right of the test diagram are combined with various hotkeys (the *hotkeys Freq., Channel* and *Offset* are associated with the softkey *Frequency* in the example below*)*. If a softkey is selected and an associated hotkey pressed, a popup window will appear which indicates the current setting and enables an entry.

Example:

Frequency The *Frequency* softkey displays a hotkey bar including the hotkey *Frequency*.

Frequency The *Frequency* hotkey opens the input window *Frequency*.



Frequency

856.2 MHz

Input windows indicate the current parameter value (in this case: the frequency of the ongoing measurement) or a list of the possible settings. Parameters are changed by

- overwriting/incrementing numerical values (for numerical parameters)
- selecting from the list of parameters (for select parameters)

The measurement menu *Power vs Time* is opened from the main menu *Menu Select* (with the associated key at the front of the instrument) or using the *Power* hotkey.

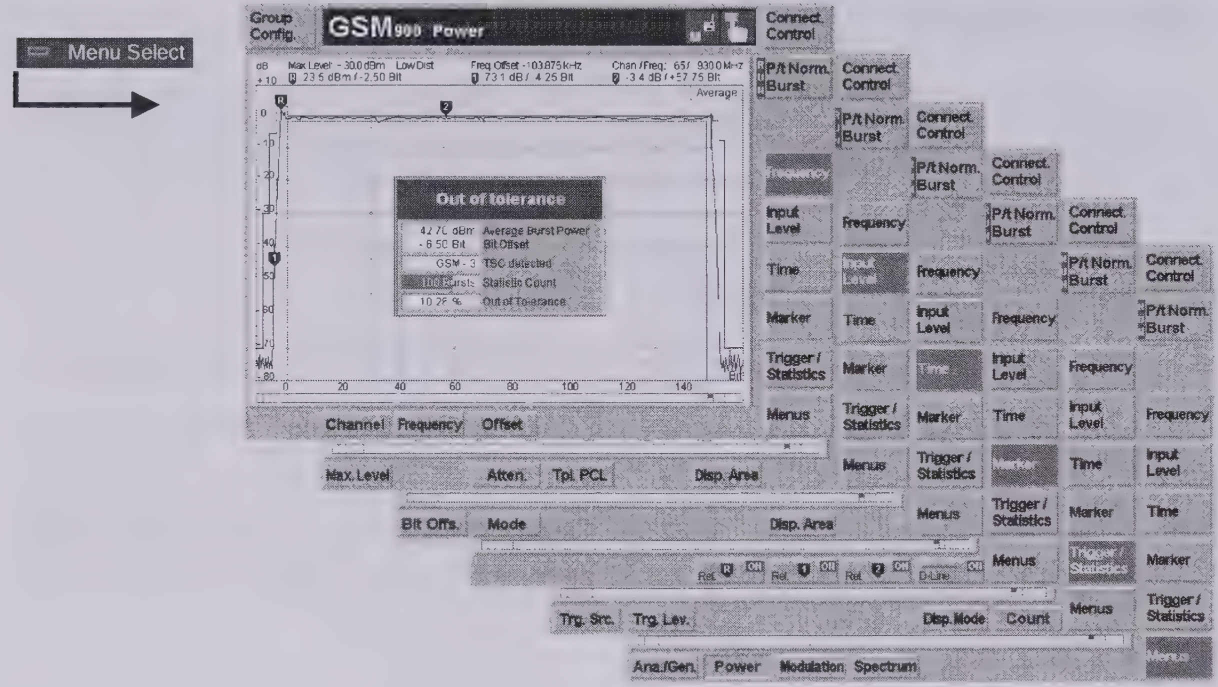

Menu Select
Group Config.
GSM900 Power
Connect. Control
P/t Norm. Burst
Out of tolerance
Average Burst Power
Bit Offset
TSC detected
Statistic Count
Out of Tolerance
Average
Frequency
Input Level
Time
Marker
Trigger / Statistics
Menus
Channel
Offset
Max. Level
Atten.
Tpl. PCL
Disp. Area
Bit Offs.
Mode
Ref.
D-Line
Trg. Src.
Trg. Lev.
Disp. Mode
Count
Ana./Gen.
Power
Modulation
Spectrum

Fig. 4-2 Measurement menu Power vs Time

Test settings

Frequency The *Frequency* softkey activates the input of the signal frequency to be measured.

Channel The *Channel* hotkey opens the input window for the channel number.

See section *Control of Input and Output Signals (Connection Control – Signal)* Panel *Analyzer Settings* on page 4.37.

Remote control `[SENSe:]RFANalyzer:CHANnel <Number>`

Frequency The *Frequency* hotkey opens the input window for the signal frequency in MHz.

See section *Control of Input and Output Signals (Connection Control – Signal)*, Panel *Analyzer Settings* on page 4.37.

Remote control `[SENSe:]RFANalyzer:CHANnel <Number>`

Offset The *Offset* hotkey opens the input window for the frequency offset.

See section *Control of Input and Output Signals (Connection Control – Signal)* Panel *Analyzer Settings* on page 4.37.

Remote control `[SENSe:]RFANalyzer:FREQuency:OFFSet <Number>`

Input Level The *Input Level* softkey sets the input level.

Max. Level

The *Max. Level* hotkey determines the maximum input level in dBm.

See section *Input Level (Group Configuration – Input Level)* on page 4.48.

Remote control `[SENSE:]LEVel:MAXimum <Level>`

Att.

The *Atten.* hotkey defines an attenuation factor for the input signal.

Normal	Input signal is maintained unchanged
Low Noise	Full dynamic range
Low Distortion	High transmission reserve

See section *Input Level (Group Configuration – Input Level)* on page 4.48.

Remote control `[SENSE:]LEVel:ATTenuation NORMal | LNOIse | LDIStortion`

Disp. Area

The *Disp. Area* hotkey defines the displayed screen area.

It is possible to select either the complete burst (see Fig. 4-6), or a particular area:

Full Range	Display of complete burst in the time range –10 bit to 157 bit and levels between –80 dBc and 10 dBc
Useful Part	Full time range, trace magnified around the reference level
Left Upper Corner	Trace magnified around the left upper corner
Rising Edge	Full level range, time axis from –10 bit to 10 bit
Right Upper Corner	Trace magnified around the right upper corner
Falling Edge	Full level range, time axis from 139 bit to 157 bit

The screen setting and the measurement do not affect each other.

Remote control No command, pure screen configuration

Time

The *Time* softkey configures the abscissa (time axis).

Bit Shift

The *Bit Shift* hotkey shifts the burst by the entered number of bits.

The burst is shifted relative to the time axis and the tolerance template for the burst analysis, see section *Limit lines (Power vs Time Configuration – Limit* Lines) on page 4.14. Therefore, the value of *Bit Offs.* affects the result of the tolerance check.

The permissible value range depends on the positioning convention for the test diagram (see below, *Mode* hotkey).

Remote control –

Mode

The *Mode* hotkey determines the time positioning of the test diagram.

GSM	GSM standard positioning; timing referenced to the transition from bit 13 to bit 14 of the training sequence
½ Bit Offset	Burst position shifted by ½ bit prior to the defined timing reference (alternative positioning accepted by GSM standard).

With the time axis, the tolerance template for the burst analysis is shifted, too. Therefore, the setting of *Mode* influences the result of the tolerance check.

Remote control `CONFigure:POWer:TIME:MODE GSM | OFFSET`

Disp. Area The *Disp. Area* hotkey determines the displayed screen area, see above.

Remote control No command, pure screen configuration

Marker The *Marker* softkey positions up to 3 markers and a D-line in the test diagram and reads their values.

Markers are graphical tools for marking points on the measurement curve and for numerical output of measured values. The measurement menu *Power* provides a reference marker and two further markers which permit to measure spacings (delta marker 1 and 2).
The coordinates of the three markers are indicated in the format *Ordinate value (level)/abscissa value (time)* in a parameter line above the test diagram. The position of the reference marker is expressed in absolute units (level in dBm and time in bits), the delta marker by absolute or relative values (relative level in dB or time differences from the reference marker).

D-line The D-line is a horizontal line that can be positioned to mark and read out an arbitrary level in the test diagram.

Ref R The hotkey *Ref. R* switches the reference marker on or off.

The reference marker is represented by the symbol R in the test diagram. The marker position (abscissa) is defined in the input field *Ref. Marker R*. The marker can be positioned to arbitrary time values. It is switched off in the default setting *(Off)*. The marker level is given by the trace at the marker position.

The position of all markers can be varied using the roll-key.

Remote control No command, screen configuration only

Rel 1 The *Rel. 1* hotkey switches the delta marker 1 on or off.

The delta marker 1 is represented by the symbol 1 in the test diagram. The marker position (abscissa) is defined in the input field *Rel. Marker 1*. The marker can be positioned to arbitrary time values. If its position is outside the diagram area it will be invisible and its coordinates will be "<abscissa_value> / - - -". The marker is switched off in the default setting *(Off)*. The marker level is given by the trace at the marker position.

The toggle switch *Rel 1 Config* pops up when the hotkey is pressed for the second time. It defines whether the position of delta marker 1 is measured and indicated in absolute units (dBm) or relative to the reference marker.

Remote control No command, pure screen configuration

Rel 2 The *Rel. 2* hotkey switches the delta marker 2 on or off (use the *ON/OFF* key).

Functions and remote control are analogous to delta marker 1.

D-Line The *D-Line* hotkey switches the D-line in the test diagram on or off.

The D-line is a horizontal, colored auxiliary line in the test diagram and is used for marking a level value and for measuring level differences. The level (ordinate) is determined in the input field *D-Line* and indicated on the D-line. The permissible value range is the diagram area, the default setting is Off.

The switch *D-Line Config.* is opened by pressing *D-Line* twice and determines whether the D-line level is expressed in absolute units (in dBm, setting absolute) or relative to the Max. Level (in dB, setting relative).

Remote control `No command, pure screen configuration`

Trigger Statistics

The *Trigger/Statistics* softkey sets the trigger condition, the statistics mode and the number of statistics cycles.

Trg. Src.

The *Trg. Src.* hotkey determines the trigger condition.

Free Run	Triggering via TDMA timing (synchronization information in bit 13/14 of the training sequence)
RF Power	Triggering on power (rising edge) of incoming burst, broadband trigger at front end
IF Power	Narrow-band trigger
Extern	External trigger signal fed in via connector AUX3

See section *Trigger (Group Configuration – Trigger)* on page 4.50.

Remote control

```
TRIGger[:SEQuence]:SOURce
          IMMediate | RFPOWer | IFPOWer | EXTern
```

Trg. Lev.

The *Trg. Lev.* hotkey determines the trigger level.

This softkey is enabled for trigger source *RF Power* or *IF Power* only. See section Trigger (Group Configuration – Trigger) on page 4.50.

Remote control

```
TRIGger[:SEQuence]:THReshold LOW | MEDium | HIGH
```

Disp. Mode

The hotkey *Disp. Mode* determines the display mode.

See section *Statistics Cycles (Power vs Time Configuration – Statistics)* on page 4.16.

Remote control

no display mode set, the four traces are accessible via

```
FETCh:ARRAy:POWer[:RESult]:BURSt[:CURRent]?
FETCh:ARRAy:POWer[:RESult]:BURSt:MINimum?
FETCh:ARRAy:POWer[:RESult]:BURSt:MAXimum?
FETCh:ARRAy:POWer[:RESult]:BURSt:AVERage?
```

etc.

Count

The hotkey *Count* defines the number of bursts per statistic cycle.

1 to 1000 Bursts	Number of bursts per statistics cycle,

See section *Statistics Cycles (Power vs Time Configuration – Statistics)* on page 4.16.

Remote control

```
CONFigure:POWer:CONTrol <Mode>,1 ... 1000 | NONE
```

Menus

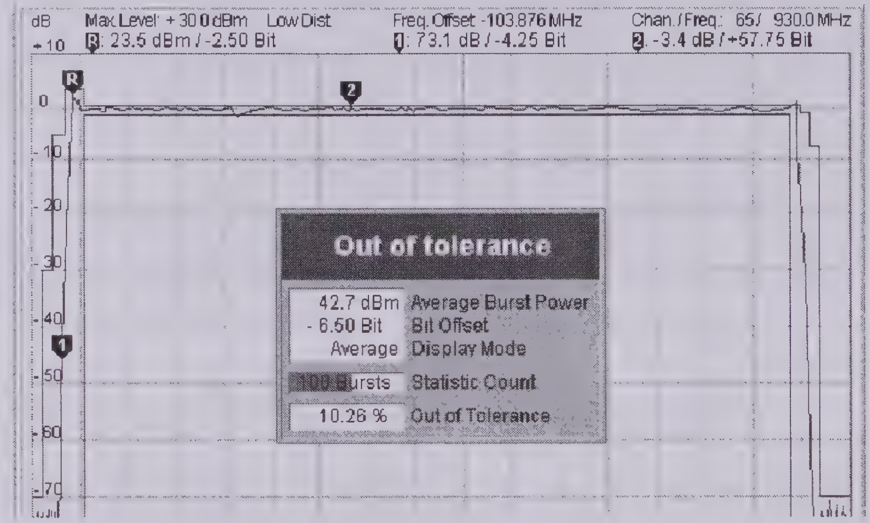
The *Menus* softkey displays the hotkey bar for changing to the other measurement menus.

Measurement Results

The values shown in the measurement menu *Power vs Time* can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (the trace plotted as a function of time)

These values are indicated in two parameter lines, the test diagram and an info box:



Parameter line 1, 2

Test diagram

Info box

dB Max.Level: +30.0 dBm Low Dist Freq. Offset -103.876 MHz Chan./Freq.: 65/ 930.0 MHz

R: 23.5 dBm / -2.50 Bit 1: 73.1 dB / -4.25 Bit 2: -3.4 dB / +57.75 Bit

Out of tolerance

42.7 dBm	Average Burst Power
- 6.50 Bit	Bit Offset
Average	Display Mode
100 Bursts	Statistic Count
10.26 %	Out of Tolerance

Fig. 4-3 Display of measurement results (Power vs Time menu)

Settings/ scalar measurement results Settings and scalar measurement results are indicated in the two parameter lines above the test diagram and in the info box, a popup window in the middle of the graphical screen *Power vs Time.*

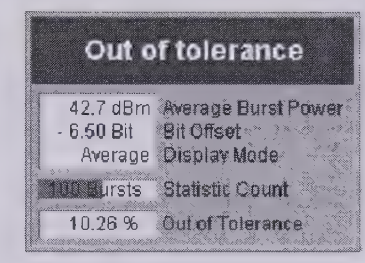
1st parameter line The first parameter line contains the following settings:

Max. Level	Maximum value of input level as set in *Input Level – Max. Level* (see p. 4.48).
Attenuation	Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)* set as in *Group Config. – Input Level* (see p. 4.48).
Freq. Offset	Frequency offset with respect to the nominal channel frequency
Chan./Freq.	RF channel and associated frequency

2nd parameter line The second parameter line contains the following marker values:

R	Level and time of reference marker
1	Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)
2	Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)

Info box



Out of tolerance

42.7 dBm	Average Burst Power
- 6.50 Bit	Bit Offset
Average	Display Mode
100 Bursts	Statistic Count
10.26 %	Out of Tolerance

The info box contains the following settings:

Bit Offset	Shifting of the burst with respect to the time axis and the tolerance template. In the measurement with signalling, the measured timing advance error is displayed instead.
Display Mode	Type of display: Minimum, Maximum, Average, Current,
Statistic Count	Number of bursts per statistics cycle.

In addition, the following scalar results are indicated:

Average Burst P.	Average power of current burst (irrespective of the display mode selected and of the current trace).
Out of Tolerance	Relative number of bursts that are out of the tolerances defined by the limit lines.
Burst Matching	Error message if the displayed burst is out of tolerance. This message depends on the selected display mode.

Remote control

Settings are read out using the query corresponding to the setting command (setting command with appended question mark).

For scalar measurement results:

```
READ[:SCALar]:POWer[:RESult]
CALCulate:POWer[:RESult]:LIMit:MATChing?
FETCh[:SCALar]:POWer[:RESult]?
SAMPle[:SCALar]:POWer[:RESult]?
```

Traces (arrays)

The measurement result is displayed as a continuous trace in the test diagram together with the limit lines, markers and the D-line, if defined.

The trace in the *Power vs Time* measurement menu shows the measured burst power (in dB) as a function of time (in bits). The displayed result depends on the test settings. The display mode for the trace *(Minimum, Maximum, Average, Current)* is indicated in the upper right corner of the diagram.

The scale of both axes can be adjusted via the *Disp. Area* hotkey (see above).

Remote control

```
READ:ARRay:POWer[:RESult]:BURSt...
CALCulate:POWer[:RESult]:LIMit:MATChing?
FETCh:ARRay:POWer[:RESult]:BURSt...?
SAMPle:ARRay:POWer[:RESult]:BURSt...?
```

Measurement Configurations (Power vs Time Configuration)

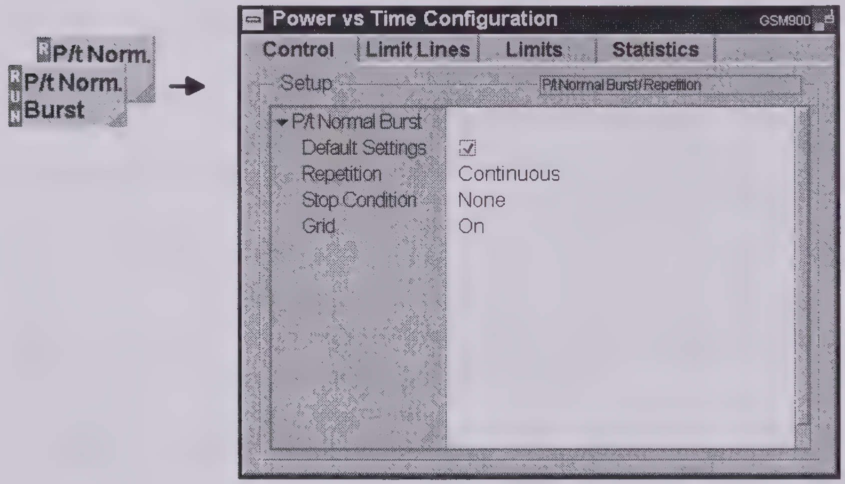
The popup menu *Power vs Time Configuration* contains three index cards which determine the parameters of the power measurement and provide graphical tools for evaluation of the measurement results.

The popup menu *Power vs Time Configuration* is activated by pressing the softkey *Power vs Time* at the top right in the graphical measurement menu *Power vs Time* twice. It is possible to change between the index cards by pressing the associated hotkeys.

Measurement Control (Power vs Time Configuration – Control)

The index card *Control* controls the power measurement by determining

- the *Repetition* mode,
- the *Stop Condition* for the measurement.
- Besides, it configures the diagram by adding a *Grid* or not.



Setup: P/t Normal Burst/Repetition

Default Settings ☑

Repetition Continuous

Stop Condition None

Grid On

Fig. 4-4 Power vs Time Configuration – Control

Default Settings The *Default* switch assigns default values to all parameters of the *Control* index card.

Repetition The *Repetition* field determines the repetition mode:

Single Shot Single-shot measurement: the measurement is stopped after a statistics cycle, i.e. after the number of bursts/evaluation periods set in the configuration menu *Statistics* (page 4.16). It is stopped even before if the stop condition *On Limit failure* is set and if an error is detected during this cycle. A stopped measurement is indicated by the status display *HLT* in the softkey *Power.*

Continuous Continuous measurement: The CMU continues the measurement until it is terminated explicitly or until the stop condition (see below) for the measurement is met. The measurement results are valid after one statistic cycle; however, the measurement is continued, and the output is continuously updated. An ongoing measurement is indicated by the status display *RUN* in the softkey *Power.*

Single shot should be selected if only a single measurement result is required under fixed conditions. The continuous measurement is suitable for monitoring the evolution of a measured quantity in time, for example for adjustments.

Note: *In remote mode, the counting measurement (counting mode) is available as a further measurement mode with a defined number of measurement cycles to be performed, see chapter 6 of this manual.*

Remote control

```
CONFigure:POWer:CONTrol:REPetition
        CONTinuous | SINGleshot | 1 ... 10000,<StopCondition>,
                                                <Stepmode>
```

Stop Condition

The *Stop Condition* field defines a stop condition for the measurement:

NONE	Continue measurement even in case of error
On Limit Failure	Stop measurement in case of error (tolerance exceeded)

The stop conditions may have different effects on single-shot and continuous measurements (see above):

Example: *Assuming that with stop condition* On Limit Failure *the tolerance is not exceeded during a statistic cycle, the end of the measurement and its error status depends on the repetition mode:*

- *A single-shot measurement is aborted after one statistic cycle, no limit is exceeded.*
- *A continuous measurement is continued after the end of the statistic cycle until the first burst with exceeded tolerance is found.*

Remote control

```
CONFigure:POWer:CONTrol:REPetition
         <Repetition>,SONerror | NONE, <Stepmode>
```

Grid

The *Grid* button switches the grid on or off in the graphical test diagram. By default, the grid is switched on.

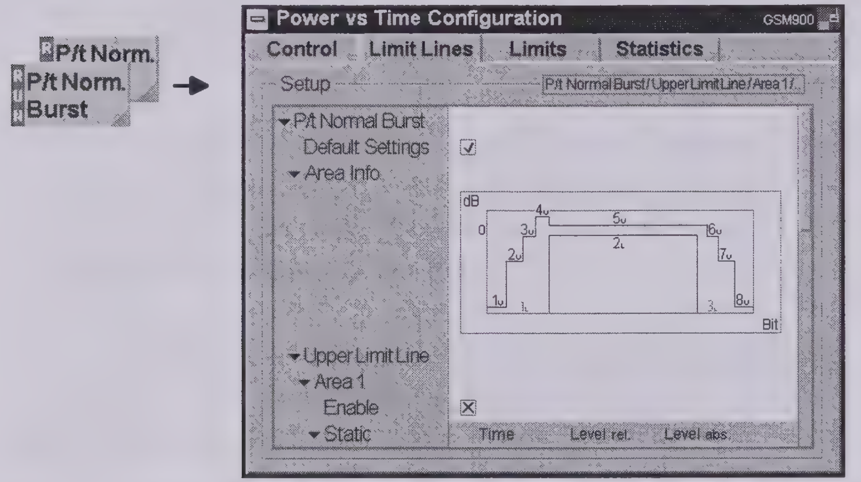
Remote control

```
CONFigure:POWer:CONTrol:GRID  ON | OFF
```

Limit lines (Power vs Time Configuration – Limit Lines)

The index card *Limit Lines* defines the limit lines for the Power vs. Time measurement. Limit lines are a graphical tool for defining and monitoring tolerance values. The index card enables

- Definition of the limit lines for the normal burst section by section *(Limit Line Definition)*
- A drawing of the default limit lines *(Preview Upper/Lower Limits)*



P/t Norm.
P/t Norm.
Burst

Power vs Time Configuration GSM900
Control | Limit Lines | Limits | Statistics

Setup: P/t Normal Burst / Upper Limit Line / Area 1 /..

- P/t Normal Burst
  - Default Settings ☑
  - Area Info
  - Upper Limit Line
    - Area 1
      - Enable ☒
      - Static: Time | Level rel. | Level abs.

Fig. 4-5 Power vs Time Configuration – Limit Lines

Burst structure in GSM mobile radio network

In the GSM mobile radio network, all radio channels are divided into frames with 8 timeslots, each with a duration of 15/26 ms ≈ 577 µs. In this time mask, bursts with various types of bit patterns are transferred:

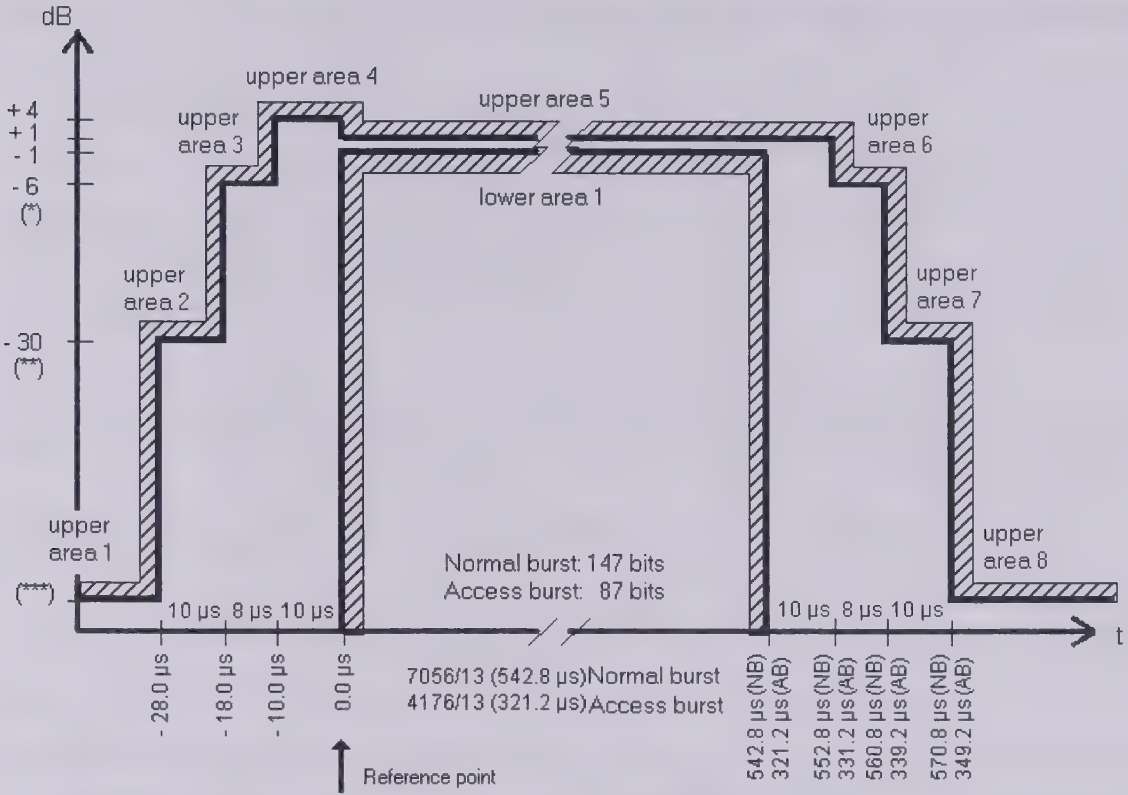
• Normal burst	Data transmission in the traffic channel and in the control channels except RACH.
• Access burst	Allows the mobile (MS) first access to the base station (BTS) in order to determine the timing advance.
• Further burst types	Dummy burst, frequency correction burst, synchronization burst, are only used by the BTS.

The data transmission rate in GSM is 270.833 kbit/s, resulting in a bit duration of 3.69 µs/bit. The bit structure of the normal burst is shown in Fig. 4-23.

As a function of time, the power ramp for normal (NB) and access bursts (AB) can be divided into different areas. These areas are used as a basis for the definition of the limit lines and are shown in the following diagram (Fig. 4-6).

Note that in upper areas 2 and 7, the limit lines depend on the PCL of the mobile phone. In the CMU, this can be taken into account by defining a PCL-dependent, dynamic correction to the static limit lines, which is explained in the *Limit Lines* section of the *Signalling* mode (see p. 4.67).

Note: *The burst type analyzed in the* Non Signalling *mode is the normal burst. The reference level (0 dB line) is equal to the received transmitter carrier power, i.e. the average value of the transmitter carrier power over the useful part of the burst as received by the CMU. The burst is fitted into the tolerance template such that the transition between bit 13/14 of the training sequence corresponds to the center of the useful part of the burst. This timing reference can be modified via the* Time *softkey, see section* Test settings *on page 4.6.*


dB
+4
+1
-1
-6
(*)
-30
(**)
(***)
upper area 1
upper area 2
upper area 3
upper area 4
upper area 5
lower area 1
upper area 6
upper area 7
upper area 8
10 µs 8 µs 10 µs
10 µs 8 µs 10 µs
Normal burst: 147 bits
Access burst: 87 bits
t
- 28.0 µs
- 18.0 µs
- 10.0 µs
0.0 µs
7056/13 (542.8 µs)Normal burst
4176/13 (321.2 µs)Access burst
542.8 µs (NB)
321.2 µs (AB)
552.8 µs (NB)
331.2 µs (AB)
560.8 µs (NB)
339.2 µs (AB)
570.8 µs (NB)
349.2 µs (AB)
Reference point

	GSM900-MS	GSM1800/1900-MS
(*)	–4.0 dBc for power control level (PCL) 16; –2.0 dBc for PCL 17; –1.0 dBc for PCL 18 and 19.	–4.0 dBc for PCL 11 –2.0 dBc for PCL 12 –1.0 dBc for PCL 13, 14, and 15.
(**)	–30.0 dBc or –17.0 dBm (higher value)	–30.0 dBc or –20.0 dBm (higher value)
(***)	–59.0 dBc or –36.0 dBm (higher value)	-48 dBc or -48 dBm (higher value)

Fig. 4-6 Tolerance template (limit lines) for normal and access bursts according to GSM specifications

Default Settings The *Default* switch sets overwrites all values of the *Limit Lines* index card with default settings (the default values are quoted in the command description in chapter 6 of this manual).

Remote control `CONFigure:POWer:LIMit:LINE:DEFault  ON | OFF`

Area Info The *Area Info* diagram represents a simplified preview of the defined tolerance template.

Remote control –

Upper Limit Line The table *Upper Limit Line* defines the upper limit lines for normal bursts. The normal burst can be divided into up to 16 areas *(Area 1 to Area 16)*; within an area, the limit line represents a line section with arbitrary (even infinite) slope. In all areas, the static limit lines can be corrected (shifted) by adding a dynamic (i.e. PCL-dependent) correction. The CMU's power template is thus far more flexible than the GSM template shown above.

Static limit lines The *static* limit lines are defined as follows:

Area 1 to 16	Area number
Enable	Enabled (switch on) or disabled (and invisible) limit line. A disabled limit line implies that the limit check for the area is switched off as well.
Time	Start and (below) stop time of the area in bits
Level rel.	Start and (below) stop level of the area in units relative to the carrier. This means that the reference level (0-dB line) is the carrier power averaged over the useful part of the burst.
Level abs.	Start and (below) stop level of the section in absolute units (dBm).

The input of relative and absolute limit values is optional; both can be switched off for valid areas (setting *Off)*. If both absolute and relative limit values are specified in an area, the tolerance template and the results of the limit check refer to the **looser** criterion.

The permissible ranges for the upper and lower limit lines, i.e. of the quantities *Time, Level rel.*, and *Level abs.* vary according to the area numbers, see command description in chapter 6.

Remote control

```
CONFigure:POWer:LIMit:LINE:UPPer<nr>:NORMal[:ENABle] ON | OFF
CONFigure:POWer:LIMit:LINE:UPPer<nr>:NORMal
<StartTime>,<EndTime>,<StartRelLevel>,<EndRelLevel>,
<StartAbsLevel>,<EndAbsLevel>,<Visibility>
```

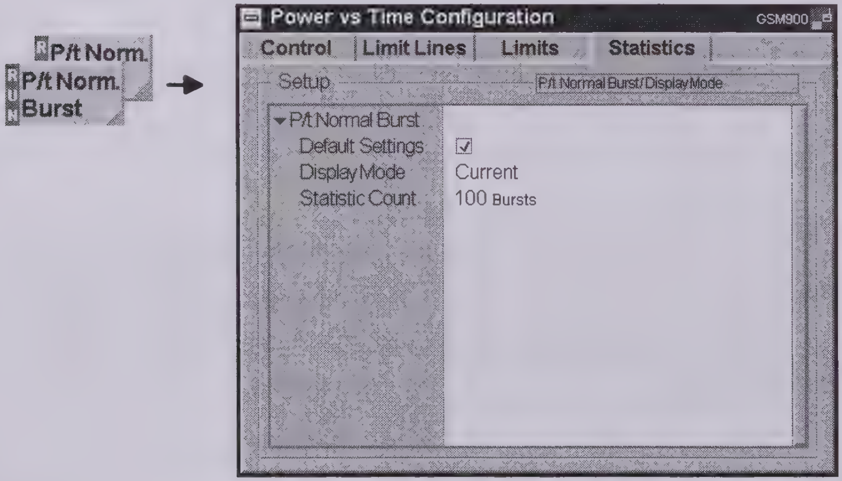
Lower Limit Line The table *Lower Limit Line* defines the lower limit lines for normal bursts. All settings are analogous to the upper limit lines.

```
CONFigure:POWer:LIMit:LINE:LOWer<nr>[:NORMal][:ENABle] ON|OFF
```

```
CONFigure:POWer:LIMit:LINE:LOWer<nr>[:NORMal]
<StartTime>,<EndTime>,<StartRelLevel>,<EndRelLevel>,
<StartAbsLevel>,<EndAbsLevel>,<Visibility>
CONFigure:POWer:LIMit:LINE:LOWer<nr>:MODE
```

Statistics Cycles (Power vs Time Configuration – Statistics)

The index card *Statistics* defines the number of bursts/evaluation periods forming a statistics cycle *(Statistic Count)* and the power ramp displayed *(Display Mode)*.



Default Settings ☑
Display Mode Current
Statistic Count 100 Bursts

Fig. 4-7 Power vs Time Configuration – Statistics

Default

The *Default* switch assigns default values to all parameters of the *Statistics* index card.

Remote control

```
CONFigure:POWer:CONTrol:DEFault  ON | OFF
```

Display Mode

The *Display Mode* field defines which of the four measured and calculated traces is displayed. The traces differ in the way the burst power *p(t)* at a fixed point in time *t* is calculated if the measurement extends over several bursts:

Current	Measured value for current burst
Minimum	Minimum over a number of bursts
Maximum	Maximum over a number of bursts
Average	Average value over a number of bursts

The number of bursts for calculation of the statistics values *Minimum, Maximum* and *Average* – and thus the result – depends on the measurement mode set (see section *Measurement Control (Power vs Time Configuration – Control)* on page 4.12). In detail, this implies:

Single shot	Display of minimum, maximum and average value from the performed statistics cycle,
Continuous	Display of minimum and maximum from all bursts already measured. The **average value**, however, refers to the last statistics cycle.

Remote control

no display mode set explicitly, the four traces are accessible via

```
FETCh:ARRAy:POWer[:RESult]:BURSt[:CURRent]?
FETCh:ARRAy:POWer[:RESult]:BURSt:MINimum?
FETCh:ARRAy:POWer[:RESult]:BURSt:MAXimum?
FETCh:ARRAy:POWer[:RESult]:BURSt:AVERage?
```

etc.

Statistic Count

The input field *Statistic Count* defines the length of the statistics cycles in bursts.

1 to 1000 Bursts	Number of bursts per statistics cycle

The settings *1* and *OFF* (press *ON/OFF* key) are equivalent. A statistics cycle is equal to the duration of single-shot measurements (see section *Measurement Control (Power vs Time Configuration – Control)* on page 4.12).

Remote control

```
CONFigure:POWer:CONTrol  <MODE>,1 ... 1000 | NONE
```

Modulation Measurements

The menu group *Modulation* comprises the functions for measurement of the modulation parameters, i.e. the frequency and phase errors in the burst and matching of the respective tolerance limits. The measurement results are displayed in the graphical measurement menu *Modulation,* the popup menu *Modulation Configuration* is used for configuration of the measurements.

Frequency and phase errors are determined as follows:

The actual phase of the signal received from the base station is recorded during the entire burst and stored. The transferred data is demodulated and the training sequence searched for. The middle of the training sequence is used for time synchronization (transition between bit 13/14).

The complete data content of the burst is then mathematically modulated using an ideal modulator. The resulting ideal phase is compared with the measured phase. From the difference between the two quantities (the phase difference trajectory), a regression line is calculated using the Mean Square Error method. The *phase error* is the difference between the phase difference trajectory and the regression line; it is calculated and plotted over the whole useful part of the burst (147 bits). The average *frequency error* in the burst is equal to the derivative of the regression line with respect to time.

For the **tolerance check** the phase error trajectory is fitted into the tolerance template and checked for tolerance violations. According to GSM specifications, a maximum peak phase error of $\pm 20^0$, a maximum RMS phase error of $\pm 5^0$, and a frequency error of 0.05 ppm referred to the carrier frequency is allowed.

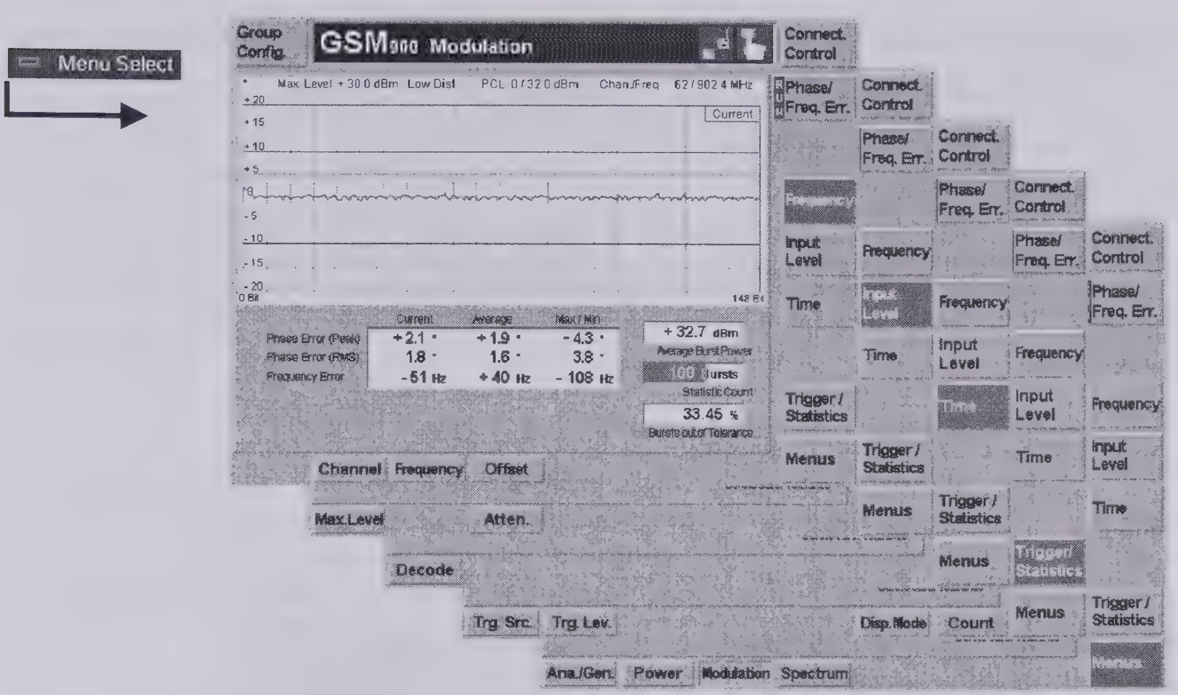
The CMU evaluates the phase error with a resolution of 4 measured values per modulating bit. This corresponds to a sampling rate of approx. 1 MHz.

Measurement Menu (*Modulation*)

The graphical measurement menu *Modulation* displays the results of the phase and frequency error analysis.

- The main softkey *Phase/Freq. Err.* indicates the measurement status *(RUN | HLT | OFF)* and opens the configuration menu *Modulation Configuration*
- The softkeys *Frequency, Input Level, Time, Trigger/Statistics,* and *Menus* to the right of the test diagram are combined with various hotkeys. If a softkey is selected and an associated hotkey pressed, a popup window will appear, which indicates a setting or enables an entry (see section *Measurement Menu (Power vs Time)* on page 4.5).

The measurement menu *Modulation* is opened from the main menu *Menu Select* (with associated key at front of instrument) or via the respective hotkey.


Menu Select
Group Config.
GSM900 Modulation
Connect. Control
Phase/ Freq. Err.
Frequency
Input Level
Time
Trigger / Statistics
Menus
+20
+15
+10
+5
0
-5
-10
-15
-20
0 Bit
148 Bit
Current
Channel
Offset
Max.Level
Atten.
Decode
Trg. Src.
Trg. Lev.
Disp. Mode
Count
Ana./Gen.
Power
Modulation
Spectrum

Max. Level +30.0 dBm Low Dist PCL 0 / 32.0 dBm Chan./Freq. 62 / 902.4 MHz

	Current	Average	Max / Min
Phase Error (Peak)	+2.1 °	+1.9 °	-4.3 °
Phase Error (RMS)	1.8 °	1.6 °	3.8 °
Frequency Error	-51 Hz	+40 Hz	-108 Hz

Average Burst Power: +32.7 dBm

Statistic Count: 100 Bursts

Bursts out of Tolerance: 33.45 %

Fig. 4-8 Measurement menu Modulation

Test Settings

The test settings for the measured frequency and the input level are identical with those in menu *Power vs. Time* (see section *Test settings* on page 4.6). They differ from the *Power vs. Time* measurement in the softkeys *Time* and *Trigger/Statistics.*

Time	The *Time* softkey configures the calculation of the phase errors in particular time intervals of the bursts.

Decode

The *Decode* hotkey defines whether guard or tail bits are decoded or not.

Guard and tail bits are located at the beginning and the end of a normal burst (see Fig. 4-23), which is why they also affect the phase error at the beginning and the end of the useful information and therefore the frequency error. The CMU offers two settings:

Standard	Guard and tail bits are assumed to be in line with GSM. If the base station does actually not send these bits correctly, large phase errors will be measured at the beginning and end of the useful information.
Guard & Tailbits	Guard and tail bits are also decoded. This avoids excessive phase errors in the case of bursts that do not comply with the standard.

Remote control –

Trigger/ Statistics	The *Trigger/Statistics* softkey sets the trigger condition, the display mode and the number of statistics cycles.

Trg. Src.

The *Trg. Src.* hotkey defines the trigger source.

See section Trigger (Group Configuration – Trigger) on page 4.50.

Remote control

```
TRIGger[:SEQuence]:SOURce
           IMMediate | RFPOWer | IFPOWer | EXTern
```

Trg. Lev.

The *Trg. Lev.* hotkey defines the trigger threshold.

This softkey is enabled for trigger source *RF Power* or *IF Power* only. See section Trigger (Group Configuration – Trigger) on page 4.50.

Remote control

```
TRIGger[:SEQuence]:THReshold LOW | MEDium | HIGH
```

Disp. Mode

The *Disp. Mode* hotkey defines the display mode.

Current	Measured value for current burst
Minimum/Maximum	Extreme value of a number of bursts
Average	Average value of a number of bursts

See section *Statistics Cycles (Modulation Configuration – Statistics)* on page 4.24.

Remote control

No display mode set explicitly, the four traces are accessible via

```
FETCh:ARRAy:MODulation[:RESult]:BURSt[:CURRent]?
FETCh:ARRAy:MODulation[:RESult]:BURSt:MINimum?
FETCh:ARRAy:MODulation[:RESult]:BURSt:MAXimum?
FETCh:ARRAy:MODulation[:RESult]:BURSt:AVERage?
```

etc.

Count

The *Count* hotkey determines the length of the statistics cycles.

1 to 1000 Bursts Number of bursts/evaluation periods per statistics cycle

See section *Statistics Cycles (Modulation Configuration – Statistics)* on page 4.24.

Remote control

```
CONFigure:MODulation:CONTrol <Mode>,1 ... 1000 | NONE
```

Menus

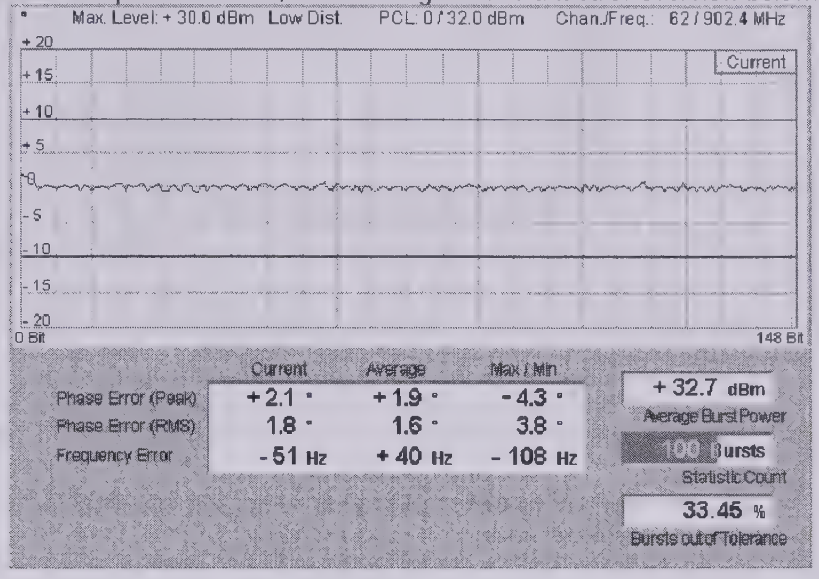
The *Menus* softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The values shown in the measurement menu *Modulation* can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (the phase error trajectory)

The values are indicated in a parameter line, the test diagram and a tabular overview below:



Max. Level: + 30.0 dBm Low Dist. PCL: 0 / 32.0 dBm Chan./Freq.: 62 / 902.4 MHz

	Current	Average	Max / Min
Phase Error (Peak)	+ 2.1 °	+ 1.9 °	- 4.3 °
Phase Error (RMS)	1.8 °	1.6 °	3.8 °
Frequency Error	- 51 Hz	+ 40 Hz	- 108 Hz

+ 32.7 dBm
Average Burst Power

100 Bursts
Statistic Count

33.45 %
Bursts out of Tolerance

Parameter line 1,2

Test diagram

Output table

Fig. 4-9 Display of results (modulation menu)

Settings/ Scalar results Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the output table below.

Parameter line The first parameter line contains the following settings:

Max. Level	Maximum input level set as in *Input Level – Max. Level* (see "Input Level (Group Configuration – Input Level) on page 4.48)
Attenuation	Setting for the external attenuation of the input level *(Normal, Low Noise, Low Distortion)*
Freq. Offset	Frequency offset with respect to the nominal channel frequency
Chan./Freq.	RF channel and associated frequency

Remote control The settings are read out using the query corresponding to the setting command (setting command with appended question mark).

Output table The output table contains the following scalar values:

Average Burst P.	Average power of current burst (irrespective of the display mode selected and of the current trace),
Statistic Count	Length of statistics cycle in bursts. The colored bar indicates the relative measurement progress in the statistics cycle.
Bursts out of Tolerance	Percentage of bursts which violate the tolerance limits.

The following scalar values are calculated for the current burst first. From the current results the average over a statistics cycle (*Average*) and the extreme value over all bursts measured so far *(Max/Min)* is calculated:

Phase Error (Peak)	Maximum phase error
Phase Error (RMS)	Effective phase error (RMS-averaged over the burst)
Frequency Error	Frequency error

Remote control

```
READ[:SCALar]:MODulation[:RESult]
FETCh[:SCALar]:MODulation[:RESult]?
SAMPle[:SCALar]:MODulation[:RESult]?

CALCulate:MODulation[:RESult]:LIMit:MATChing?
```

Traces (arrays)

The continuous trace in the test diagram shows the phase error in the burst (in degrees) as a function of time (in bits). The display mode *(Current, Max./Min., Average)* for the trace is indicated in the upper right corner of the diagram.

The scale of both axes is fixed. The trace comprises the whole useful part of the normal burst (bit 0 to 147). The y-axis ranges from -20^0 to $+20^0$.

Due to the definition of the phase error (see shaded section on page 4.18), the phase error oscillates around the center of the diagram: The 0^0 line is equal to the regression line of the phase error trajectory calculated using the Mean Square Error method.

The two colored, horizontal lines in the test diagram mark the selected tolerance range of the phase error.

Remote control

```
READ:ARRay:MODulation[:RESult]:BURSt...?
FETCh:ARRay:MODulation[:RESult]:BURSt...?
SAMPle:ARRay:MODulation[:RESult]:BURSt...?
```

Measurement Configurations (Modulation Configuration)

The popup menu *Modulation Configuration.* contains three index cards which determine the parameters of the phase and frequency error measurement including the error tolerances.

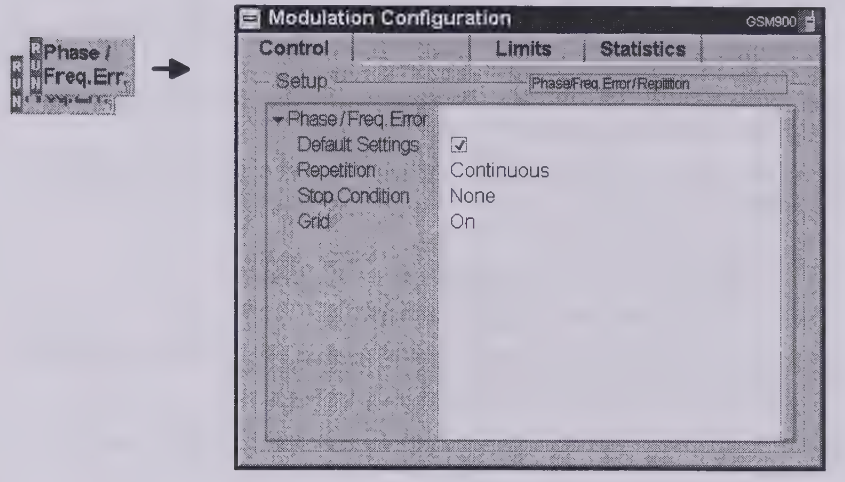
The popup menu *Modulation Configuration* is activated by pressing the softkey *Phase/Freq. Err.* in the top right of the graphical measurement menu *Modulation* twice. By pressing the associated hotkeys, it is possible to change between the index cards.

Measurement Control (Modulation Configuration – Control)

The index card *Control* controls the phase and frequency error measurement by defining

- The *Repetition* mode
- The *Stop Condition* for the measurement

Besides, it influences the measurement diagram by adding a *Grid* or not.


Phase / Freq.Err.
RUN
Modulation Configuration
GSM900
Control
Limits
Statistics
Setup
Phase/Freq. Error/Repitition

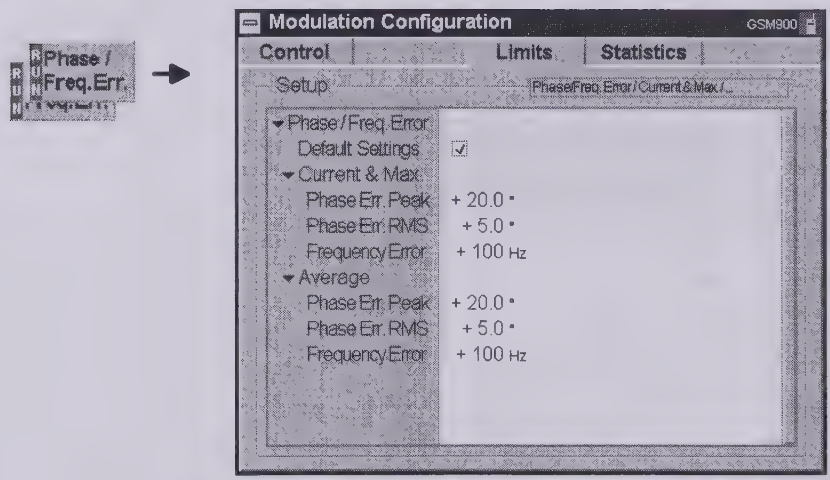
Phase / Freq. Error
Default Settings ☑
Repetition Continuous
Stop Condition None
Grid On

Fig. 4-10 Modulation Configuration – Control

The functions of this menu comply with those of the menu *Control* in the menu group *Power vs Time* (see page 4.12). In the remote-control commands, the keyword `POWer` is to be replaced by `MODulation`.

Tolerance Values (Modulation Configuration – Limits)

The index card *Limits* defines upper and lower error limits for the measured values of the phase and frequency error measurement.


Phase / Freq.Err.
RUN
Modulation Configuration
GSM900
Control
Limits
Statistics
Setup
Phase/Freq. Error/Current & Max./...

Phase / Freq. Error
Default Settings ☑
Current & Max.
Phase Err. Peak + 20.0 °
Phase Err. RMS + 5.0 °
Frequency Error + 100 Hz
Average
Phase Err. Peak + 20.0 °
Phase Err. RMS + 5.0 °
Frequency Error + 100 Hz

Fig. 4-11 Modulation Configuration – Limits

Default Settings	The *Default Settings* switch overwrites all settings in the *Limits* index card with default settings.
Remote control	`CONFigure:MODulation:LIMit:DEFault ON | OFF`
Phase/Freq. Error	The table *Phase/Freq. Error* defines upper and lower error limits for the different display modes:
	Current & Max. Display of the measured values in the current burst or of the extreme measured values of all measured bursts (Max.)

Average	Average value of the measured values derived from the last statistics cycle

For setting of the display mode see section *Statistics Cycles (Modulation Configuration – Statistics)* on page 4.24.

The meaning of the error limits is the same for single-shot (Current & Max.) and average measurement:

Phase Err. Peak	Maximum phase error
Phase Err. RMS	RMS phase error (RMS-averaged over the burst)
Frequency Error	Average frequency error in the burst

In contrast to the power measurement where individual limit lines can be switched off, the limit check is always active.

The values can be overwritten with the default settings using the *Default* button.

Remote control

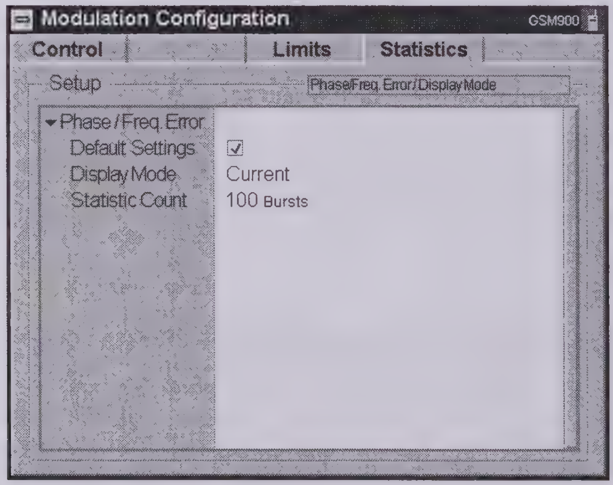
```
CONFigure:MODulation:LIMit:UPPer[:CURRent]
          <PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>
CONFigure:MODulation:LIMit:LOWer[:CURRent]
          <PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>

CONFigure:MODulation:LIMit:UPPer:AVERage
          <PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>
CONFigure:MODulation:LIMit:LOWer:AVERage
          <PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>
```

Statistics Cycles (Modulation Configuration – Statistics)

The index card *Statistics* defines the number of bursts per statistics cycle and the displayed trace *(Display Mode).*

RUN
Phase /
Freq.Err.



Phase / Freq. Error
Default Settings ☑
Display Mode Current
Statistic Count 100 Bursts

Fig. 4-12 Modulation Configuration – Statistics

Display Mode The *Display Mode* field defines which of the measured and calculated traces is displayed. The traces differ in the way the phase error $\Delta(t)$ at a fixed point in time t is calculated if the measurement extends over several bursts

Current	Measured value for the current burst
Max./Min.	Extreme value over a number of bursts

Average	Average value over a number of bursts

The number of bursts for the calculation of the statistic values *Minimum/Maximum* and *Average* – and thus the result – depends on the set measurement mode (see section *Measurement Control (Power vs Time Configuration – Control)* on page 4.12). In detail, this implies:

Single shot	Display of minimum, maximum and average value from the performed statistics cycle
Continuous	Display of minimum and maximum from all bursts already measured. The **average value**, however, refers to the last statistics cycle that has been performed.

In a power measurement absolute values are determined, whereas the measured phase error can have both positive or negative sign. To assess the phase error only the magnitude (and not the sign) is of importance so that extreme values are output in the menu *Modulation* instead of maxima and minima.

Remote control

no display mode set, the four traces are accessible via

```
FETCh:ARRAy:MODulation[:RESult]:BURSt[:CURRent]?
FETCh:ARRAy:MODulation[:RESult]:BURSt:MMAX?
FETCh:ARRAy:MODulation[:RESult]:BURSt:AVERage?
```

etc.

Statistic Count

The input field *Statistic Count* defines the length of the statistics cycles in bursts/evaluation periods.

1 to 1000 Bursts	Number of bursts per statistics cycle

The settings *1* and *OFF* are equivalent. A statistics cycle is equal to the duration of a single shot (see section *Measurement Control (Power vs Time Configuration – Control)* on page 4.12).

Remote control

```
CONFigure:MODulation:CONTrol  <MODE>,1 ... 1000 | NONE
```

Spectrum Measurements

The menu group *Spectrum* comprises the functions for measurement of the off-carrier power resulting from the modulation process *(spectrum due to modulation)* and from the bursty nature of the RF signal, i.e. the power ramping up and down *(spectrum due to switching)*. The two spectra are treated as two different applications; they are displayed in two separate graphical measurement menus *Spectrum* (applications *Due to Modulation* and *Due to Switching)*, the popup menu *Spectrum Configuration* is used for configuration of the measurements.

The *Spectrum* measurement serves to measure the amount of energy that spills outside the designated radio channel when the base station transmits at variable output power. The measurement is made in the time domain (zero frequency span mode), at a series of frequency points symmetrically distributed around the nominal frequency of the designated channel (see section *Tolerance Values (Spectrum Configuration – Limits)* on page 4.31 ff).

In GSM 05.05 and GSM 11.10, the two *Spectrum* measurements are specified in detail:

- For the *spectrum due to modulation*, the power must be averaged over 50% to 90% of the useful part of the burst, excluding the training sequence, and then averaged again over a given minimum number of bursts.
- For the *spectrum due to switching*, the peak power over a minimum number of bursts must be determined.

Additional requirements concerning the measurement bandwidths are specified.

Measurement Menu (Spectrum)

The graphical measurement menu *Spectrum* displays the results of the adjacent channel power measurement.

- The main softkey *Spectrum* indicates the measurement status *(RUN | HLT | OFF)* and opens the configuration menu *Spectrum Configuration.*
- The softkeys *Application, Frequency, Input Level, Marker, Trigger/Statistics and Menus* to the right of the test diagram are combined with various hotkeys. When a softkey is selected and an associated hotkey pressed, a popup window appears which indicates a setting or enables an entry (see section *Measurement Menu (Power vs Time)* on page 4.5).

The measurement menu *Spectrum* is opened from the main menu *Menu Select* (with associated key at front of instrument) or via the respective hotkey.

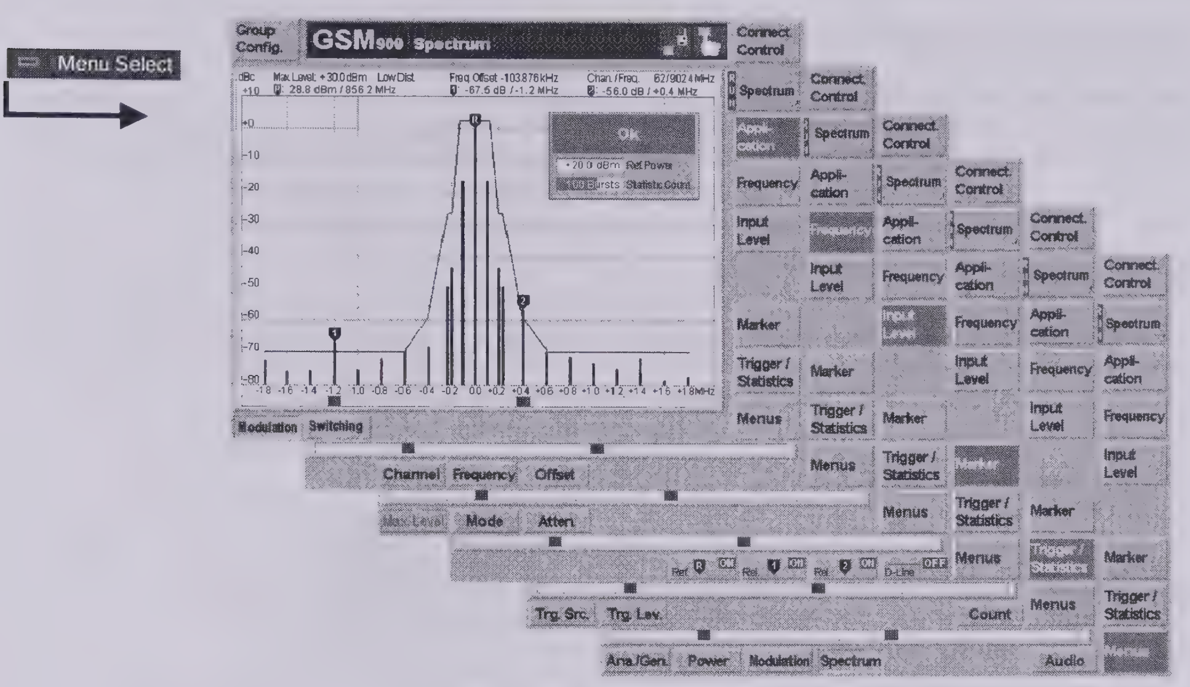

Menu Select
Group Config.
GSM900 Spectrum
Connect. Control
Spectrum
Appli-cation
Frequency
Input Level
Marker
Trigger / Statistics
Menus
Ok
+20.0 dBm Ref.Power
100 Bursts Statistic Count
Modulation
Switching
Channel
Frequency
Offset
Max. Level
Mode
Atten.
Ref.
Rel.
D-Line
ON
OFF
Trg. Src.
Trg. Lev.
Count
Ana./Gen.
Power
Modulation
Spectrum
Audio

Fig. 4-13 Measurement menu Spectrum due to Modulation

Test Settings

The *Frequency, Input Level, Marker, Trigger/Statistics,* and *Menu* settings are identical with those in the *Power* menu (see section *Test Settings* on page 4.6; no display mode can be set for frequency-domain representation). The *Spectrum* measurement differs from the *Power* measurement in the *Application* softkey.

Appli-cation

The *Application* softkey activates the selection of the type of spectrum to be measured.

The two alternative spectra (applications) are displayed in separate measurement menus. When an application is selected, the corresponding measurement menu is called up. The configuration settings for both applications, however, are listed in a common popup-menu (see p. 4.30 ff).

Modulation

The *Modulation* hotkey selects the spectrum due to modulation to be displayed.

In this mode, the power at the nominal frequency and the relative power at up to 11 neighboring frequencies is displayed in a single graph, see p. 4.28 ff.

Remote control

No explicit switchover command. All spectrum due to modulation measurements are identified by the 2nd/3rd level keywords `...SPECtrum:MODulation...`

Switching

The *Switching* hotkey selects the spectrum due to switching to be displayed.

In this mode, the power at the nominal frequency and the relative power at up to 4 neighboring frequencies is displayed in a single graph, see p. 4.29 ff.

Remote control

No explicit switchover command. All spectrum due to modulation measurements are identified by the 2nd/3rd level keywords `...SPECtrum:SWITching...`

Measurement Results

The *Spectrum* measurement menu and the results depend on the type of spectrum (application) selected. The scaling of the x-axis is equal for the two spectra. However, the spectrum due to modulation is expressed in relative units (dBc), the spectrum due to switching in absolute units (dBm).

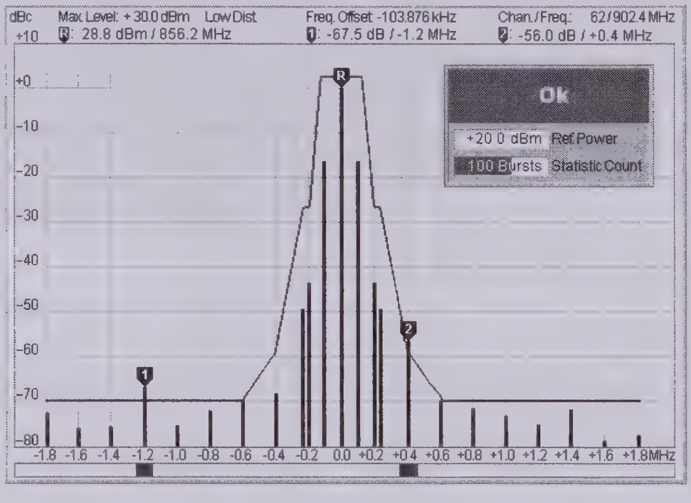
a) Spectrum due to Modulation

In the *Spectrum due to Modulation* measurement, the average burst power at a series of fixed frequency points around the selected RF frequency is displayed. The results and the corresponding settings are indicated in two parameter lines, the test diagram (bar graph), and an info box:

Parameter lines

Bar graph and

info box



Max Level: +30.0 dBm Low Dist

R: 28.8 dBm / 856.2 MHz

Freq. Offset -103.876 kHz

1: -67.5 dB / -1.2 MHz

Chan./Freq.: 62 / 902.4 MHz

2: -56.0 dB / +0.4 MHz

Ok

+20.0 dBm Ref.Power

100 Bursts Statistic Count

dBc
+10
+0
-10
-20
-30
-40
-50
-60
-70
-80
R
1
2
-1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 +0.2 +0.4 +0.6 +0.8 +1.0 +1.2 +1.4 +1.6 +1.8MHz

Fig. 4-14 Display of results (spectrum due to modulation)

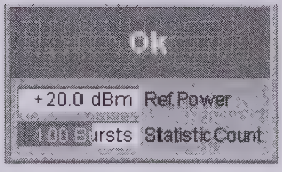
Parameter lines The first parameter line contains the following settings:

Max. Level	Maximum input level set as in *Input Level - Mode*
Attenuation	Setting for the external attenuation of the input level *(Normal, Low Noise, Low Distortion)*
Freq. Offset	Frequency offset with respect to the nominal channel frequency
Chan./Freq.	RF channel and associated frequency

2nd parameter line The second parameter line contains the following marker values:

R	Absolute level (in dBm) and frequency offset from the carrier of reference marker
1	Level (in dBm) and frequency offset of delta marker 1 (setting *absolute*). With setting *relative*, the level difference from the carrier is indicated (same as the diagram units)
2	Level and time of delta marker 2, see delta marker 1

Info box



Ok

+20.0 dBm Ref.Power

100 Bursts Statistic Count

The info box indicates the following settings and scalar results:

Ref. Power	Absolute value of the measured carrier output power of the BTS. According to GSM specifications, the *Ref. Power* is measured with a filter bandwidth of 30 kHz so that it differs from the average burst power determined in the *Power vs. Time* menu.
Statistic Count	Number of bursts per statistics cycle
Burst Matching	Error message if the displayed burst is out of tolerance. This message depends on the selected display mode.

Remote control

The settings are read out using the query corresponding to the setting command (setting command with appended question mark). The reference power and burst matching are retrieved with a single command:

```
READ[:SCALar]:SPECtrum:MODulation[:RESult]?
FETCh[:SCALar]:SPECtrum:MODulation[:RESult]?
SAMPle[:SCALar]:SPECtrum:MODulation[:RESult]?
```

Answer: `<RefPow>,<Match>`

Bar graph

The bar graph shows the current carrier output power of the BTS and the measured spectrum due to modulation at up to 11 non-equidistant frequencies that are symmetrically distributed around the carrier frequency. The diagram is scaled such that the x-axis indicating the frequency offset from the carrier ranges from –2 MHz to +2 MHz; the carrier output power forms the 0 dB reference level. The spectral tolerance mask defined in the *Limit Lines* index card (see p. 4.31 ff) is indicated in addition. The measurement result at particular frequencies can be read out by means of markers. The measurement at every single frequency point can be switched on and off in the Meas X index card (see p. 4.36).

Remote control

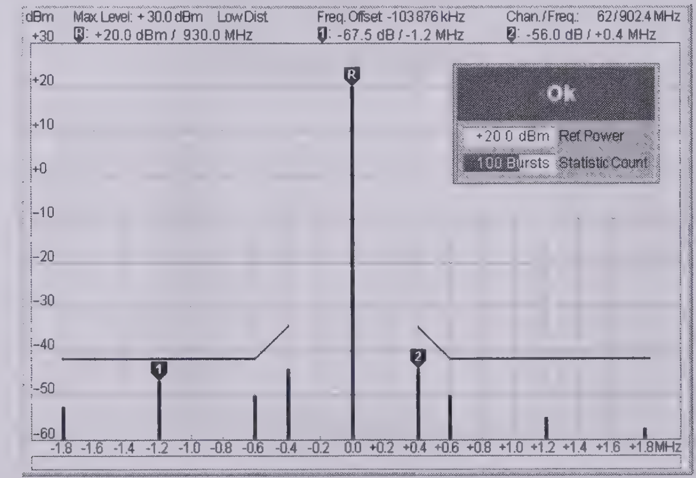
```
READ:ARRay:SPECtrum:MODulation[:RESult]?
FETCh:ARRay:SPECtrum:MODulation[:RESult]?
SAMPle:ARRay:SPECtrum:MODulation[:RESult]?
```

b) Spectrum due to Switching

In the *Spectrum due to Switching* measurement, the maximum level measured at a series of fixed frequency points around the selected RF frequency is displayed. The results and the corresponding settings are indicated in two parameter lines, the test diagram (bar graph), and an info box:

Parameter lines

Bar graph and info box



Max Level: + 30.0 dBm LowDist Freq. Offset -103 876 kHz Chan./Freq.: 62/902.4 MHz

R: +20.0 dBm / 930.0 MHz 1: -67.5 dB / -1.2 MHz 2: -56.0 dB / +0.4 MHz

Ok

+20.0 dBm Ref. Power

100 Bursts Statistic Count

dBm
+30
+20
+10
+0
-10
-20
-30
-40
-50
-60
R
1
2
-1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 +0.2 +0.4 +0.6 +0.8 +1.0 +1.2 +1.4 +1.6 +1.8MHz

Fig. 4-15 Display of results (spectrum due to switching)

The two parameter lines and the info box are identical with the *due to Modulation* menu, see above. Note that, according to GSM specifications, the *Ref. Power* is measured with a filter bandwidth of 300 kHz so that it slightly differs from the average burst power determined in the *Power vs. Time* menu.

Bar graph The bar graph shows the current carrier output power of the mobile station and the measured spectrum due to switching at up to 4 non-equidistant frequencies that are symmetrically distributed around the carrier frequency. The diagram is scaled such that the x-axis indicating the frequency offset from the carrier ranges from –2 MHz to +2 MHz; the y-axis is in absolute power units (dBm). The spectral tolerance mask defined in the *Limit Lines* index card (see p. 4.31 ff) is indicated in addition. The measurement result at particular frequencies can be read out by means of markers. The measurement at every single frequency point can be switched on and off in the Meas X index card (see p. 4.36).

Remote control

```
READ:ARRay:SPECtrum:SWITching[:RESult]?
FETCh:ARRay:SPECtrum:SWITching[:RESult]?
SAMPle:ARRay:SPECtrum:SWITching[:RESult]?
```

Measurement Configurations (Spectrum)

The popup menu *Spectrum Configuration* contains four index cards which define the parameters of the phase and frequency error measurement including the error tolerances.

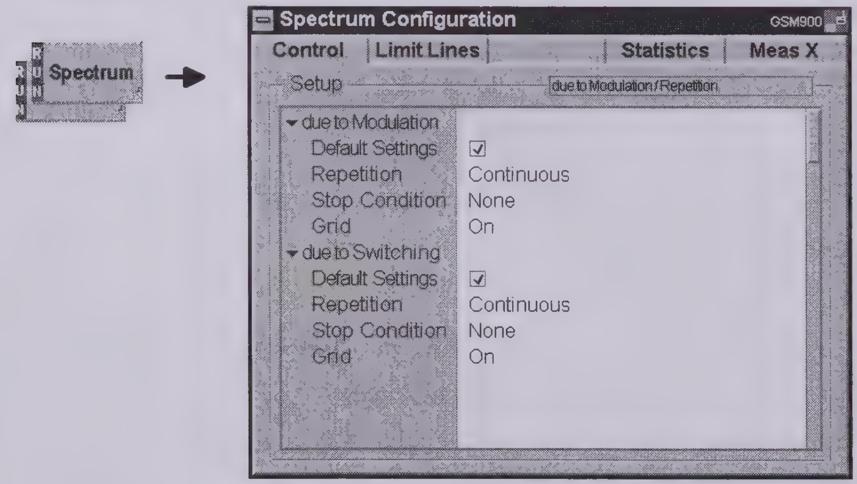
The popup menu *Spectrum Configuration* is called up by pressing the main softkey in the top right of the graphical measurement menu *Spectrum* twice (this softkey reads *due to Modulation* or *due to Switching*, depending on the selected application). By pressing the associated hotkeys, it is possible to change between the index cards.

Measurement Control (Spectrum Configuration – Control)

The index card *Control* controls the spectrum measurement by defining

- The *Repetition* mode
- The *Stop Condition* for the measurement

Besides, it influences the measurement diagram by adding a *Grid* or not.



due to Modulation / Repetition

due to Modulation
Default Settings ☑
Repetition Continuous
Stop Condition None
Grid On
due to Switching
Default Settings ☑
Repetition Continuous
Stop Condition None
Grid On

Fig. 4-16 Spectrum Configuration – Control

All settings can be defined separately for the two applications *due to Modulation* and *due to Switching.* They comply with those of the menu *Control* in the menu group *Power* (see page 4.12). In the remote-control commands, the keyword `POWer` is to be replaced by `SPECtrum:MODulation|SWITching`.

Tolerance Values (Spectrum Configuration – Limits)

The index card *Limit Lines* defines upper limits for the output spectrum around the RF carrier frequency. All relative limit values are referred to the actual carrier output power of the base station.

a) Spectrum due to Modulation

The limit lines for the *spectrum due to modulation* as specified in GSM 05.05 and GSM 11.10 depend on the GSM band, the frequency, and (for frequencies that differ from the carrier frequency by more than 400 kHz) on the output power of the mobile station. The following values apply up to a frequency offset of 1.8 MHz:

Table 4-1 GSM tolerances for spectrum due to modulation

	GSM900 Relative power at a MS output power		GSM1800/1900 Relative power at a MS output power	
Frequency offset / [MHz]	**≤ 33 dBm (in dBc)**	**≥ 39 dBm (in dBc)**	**≤ 24 dBm (in dBc)**	**≥ 36 dBm (in dBc)**
0.1	+0.5	+0.5	+0.5	+0.5
0.2	–30	–30	[tbd]	–30
0.25	–33	–33	–33	–33
0.4	–60	–60	–60	–60
≥0.6, ≤1.8	–60	–66	–60	–60

In the frequency range above 400 kHz from the carrier and for output powers between 33 dBm and 39 dBm (GSM900), the limit depends linearly on the output power. The resulting spectral mask is shown below (Fig. 4-17).

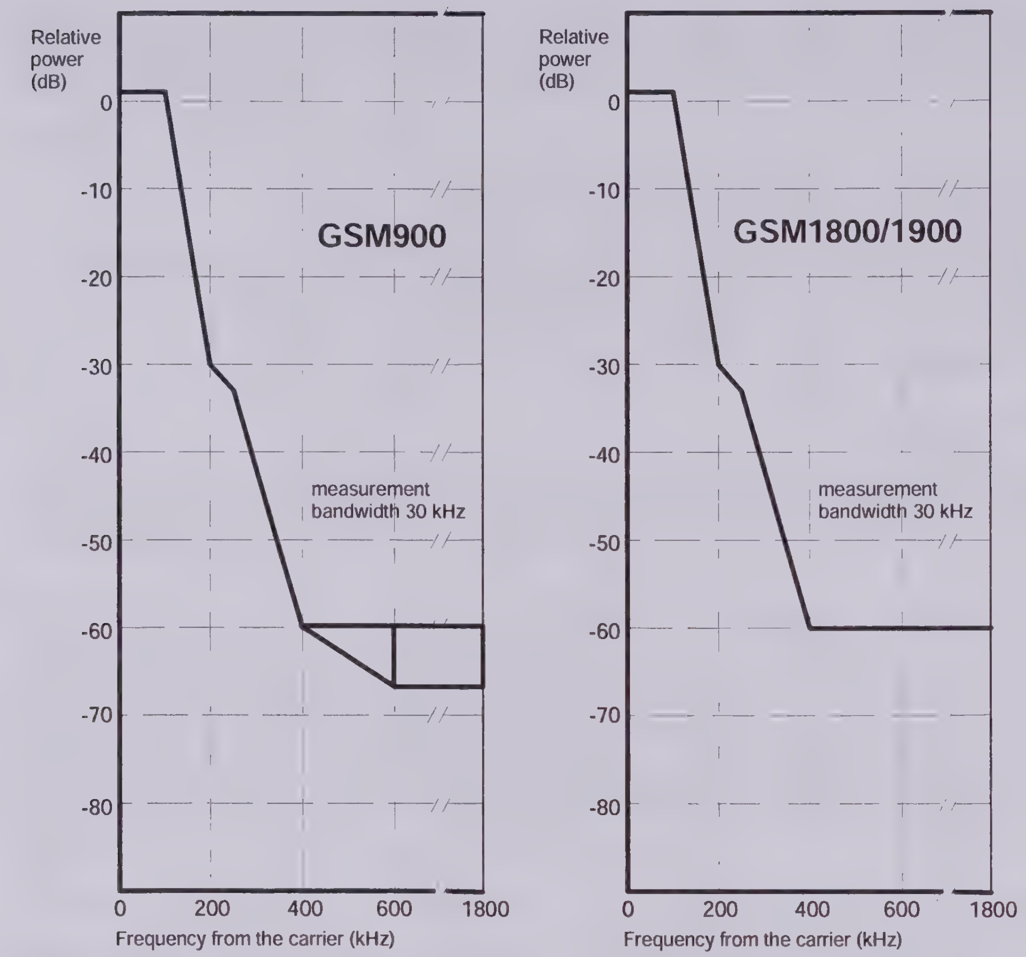


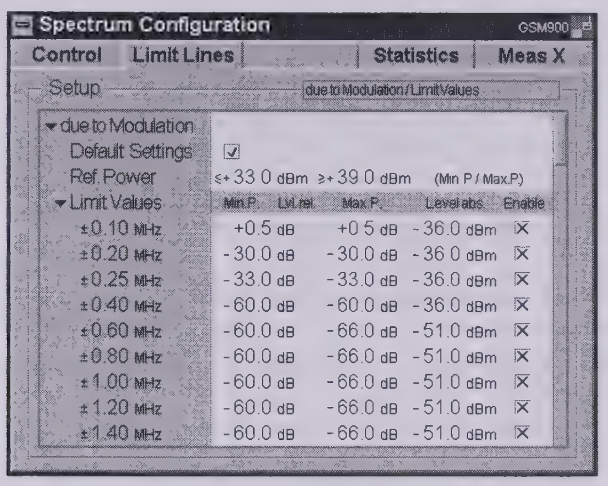
Fig. 4-17 Spectral mask as specified for GSM mobile stations

As an alternative to the relative limit values quoted in Table 4-1, GSM specifies the following absolute limits, again depending on the frequency offset from the carrier and the GSM band. If the relative limits are tighter than the absolute limits, the latter shall be applied.

Table 4-2 GSM tolerances for spectrum due to modulation (absolute)

Frequency offset / [MHz]	**Absolute power, GSM900**	**Absolute power, GSM1800/1900**
< 0.6	–36 dBm	–36 dBm
≥0.6, <1.8	–51 dBm	–56 dBm
≥1.8	–46 dBm	–51 dBm

Spectrum →



Default Settings ☑

Ref. Power ≤+33.0 dBm ≥+39.0 dBm (Min P / Max P)

Limit Values	Min P. Lvl rel.	Max P.	Level abs.	Enable
±0.10 MHz	+0.5 dB	+0.5 dB	-36.0 dBm	☒
±0.20 MHz	-30.0 dB	-30.0 dB	-36.0 dBm	☒
±0.25 MHz	-33.0 dB	-33.0 dB	-36.0 dBm	☒
±0.40 MHz	-60.0 dB	-60.0 dB	-36.0 dBm	☒
±0.60 MHz	-60.0 dB	-66.0 dB	-51.0 dBm	☒
±0.80 MHz	-60.0 dB	-66.0 dB	-51.0 dBm	☒
±1.00 MHz	-60.0 dB	-66.0 dB	-51.0 dBm	☒
±1.20 MHz	-60.0 dB	-66.0 dB	-51.0 dBm	☒
±1.40 MHz	-60.0 dB	-66.0 dB	-51.0 dBm	☒

Fig. 4-18 Spectrum Configuration – Limits

Default Settings The *Default Settings* switch sets the default power limits to the RF spectrum due to modulation. See command description in chapter 6.

Remote control `CONFigure:SPECtrum:MODulation:LIMit:LINE:DEFault ON|OFF`

Ref. Power The *Ref. Power* line defines the MS carrier output power domain where the limit lines are to be determined by linear interpolation (see Table 4-1). Below *Min. P.*, the lower limit line applies, above *Max. P.*, the upper limit line applies. The *Ref. Power* domain can be modified.

Remote control `CONFigure:SPECtrum:MODulation:LIMit:LINE:REFPOWer <POWer>`

Limit Values The *Limit Values* table section defines upper limits for the power at eleven fixed, GSM-specific frequency offsets:

Lvl. rel.	Upper limit for the RF power referred to the MS output power measured in 30 kHz on the carrier. The two values are valid for output powers below the *Ref. Power* domain *(Min. P.)* and for output powers above the *Ref. Power* domain *(Max. P.)*. Inside the *Ref. Power* domain, *Lvl. rel.* is determined by linear interpolation.
Level abs.	Alternative absolute power limits (see Table 4-2), applied if the relative limits *Lvl. rel.* are tighter.
Enable	Switches the limit check at the frequency on and off.

Remote control

```
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>
          <RelLow>,<RelUpp>,<Abs>,<Enable>
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]:MODE ON|OFF
```

b) Spectrum due to Switching

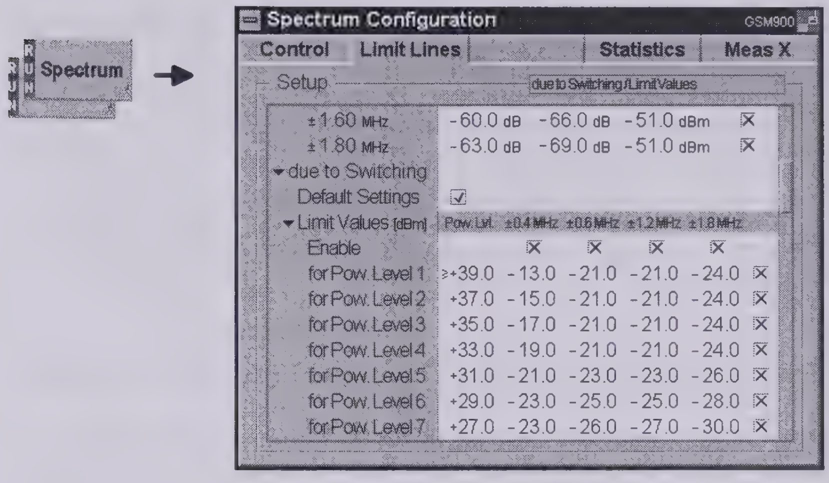
The limit lines for the *spectrum due to switching* as specified in GSM 05.05 and GSM 11.10 cover offset frequencies between 0.4 and 1.8 MHz. They are equal for all three GSM bands but depend on the output power of the mobile station. The measurement of the spectrum due to switching is complicated by the fact that at high power levels, the modulation spectrum is being measured using a peak hold measurement. The tolerances in the following table allow for the additional effects due to the modulation spectrum:

Table 4-3 GSM tolerances for spectrum due to switching plus modulation effects:

GSM900	**Maximum MS level measured (peak hold) / [dBc] at frequency offset**			
MS power / [dBm]	**0.4 MHz**	**0.6 MHz**	**1.2 MHz**	**1.8 MHz**
≥39	–13	–21	–21	–24
+37	–15	–21	–21	–24
+35	–17	–21	–21	–24
+33	–19	–21	–21	–24
+31	–21	–23	–23	–26
+29	–23	–25	–25	–28
+27	–23	–26	–27	–30
+25	–23	–26	–29	–32
+23	–23	–26	–31	–34
≤21	–23	–26	–32	–36

GSM1800	**Maximum MS level measured (peak hold) / [dBc] at frequency offset**			
MS power / [dBm]	**0.4 MHz**	**0.6 MHz**	**1.2 MHz**	**1.8 MHz**
≥36	–16	–21	–21	–24
+34	–18	–21	–21	–24
+32	–20	–22	–22	–25
+30	–22	–24	–24	–27
+28	–23	–25	–26	–29
+26	–23	–26	–28	–31
+24	–23	–26	–30	–33
+22	–23	–26	–31	–35
≤20	–23	–26	–32	–36
–	–	–	–	–

GSM1900	**Maximum MS level measured (peak hold) / [dBc] at frequency offset**			
MS power / [dBm]	**0.4 MHz**	**0.6 MHz**	**1.2 MHz**	**1.8 MHz**
≥33	–19	–22	–22	–25
+32	–20	–22	–22	–25
+30	–22	–24	–24	–27
+28	–23	–25	–26	–29
+26	–23	–26	–28	–31
+24	–23	–26	–30	–33
+22	–23	–26	–31	–35
≤20	–23	–26	–32	–36



±1.60 MHz	-60.0 dB	-66.0 dB	-51.0 dBm	☒		
±1.80 MHz	-63.0 dB	-69.0 dB	-51.0 dBm	☒		
▾ due to Switching						
Default Settings	☑					
▾ Limit Values [dBm]	Pow. Lvl.	±0.4 MHz	±0.6 MHz	±1.2 MHz	±1.8 MHz	
Enable		☒	☒	☒	☒	
for Pow. Level 1	≥+39.0	-13.0	-21.0	-21.0	-24.0	☒
for Pow. Level 2	+37.0	-15.0	-21.0	-21.0	-24.0	☒
for Pow. Level 3	+35.0	-17.0	-21.0	-21.0	-24.0	☒
for Pow. Level 4	+33.0	-19.0	-21.0	-21.0	-24.0	☒
for Pow. Level 5	+31.0	-21.0	-23.0	-23.0	-26.0	☒
for Pow. Level 6	+29.0	-23.0	-25.0	-25.0	-28.0	☒
for Pow. Level 7	+27.0	-23.0	-26.0	-27.0	-30.0	☒

Fig. 4-19 Spectrum Configuration – Limits

Default Settings The *Default Settings* switch sets the default power limits to the RF spectrum due to switching.

Remote control `CONFigure:SPECtrum:SWITching:LIMit:LINE:DEFault ON|OFF`

Limit Values The *Limit Values* table section defines upper limits for the absolute output power of the mobile station, measured at zero frequency span and with a filter bandwidth of 30 kHz.

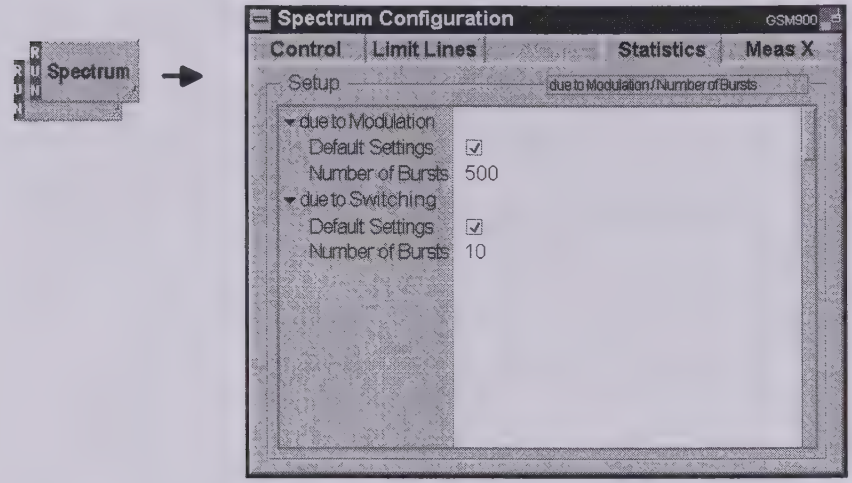
Enable	Switches the limit check at the frequency or power level on and off
Power Lvl.	User-defined MS output power level (not necessarily identical with the GSM power control levels). The CMU offers considerable flexibility with regard to the limit line definition: They are specified at four fixed, GSM-specific frequency offsets and up to 10 arbitrary MS power levels (see Table 4-3). For measured MS powers between the power levels, the limits are determined by linear interpolation.

Remote control

```
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr>
     <PowLvl>,<Value1>,<Value2>,<Value3>,<Value4>,<Enable>
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]:MODE ON|OFF
```

Statistics cycles (Spectrum Configuration – Statistics)

The index card *Statistics* defines the number of bursts forming a statistics cycle and the displayed spectrum *(Display Mode).*


RUN
Spectrum
Spectrum Configuration
GSM900
Control
Limit Lines
Statistics
Meas X
Setup
due to Modulation / Number of Bursts

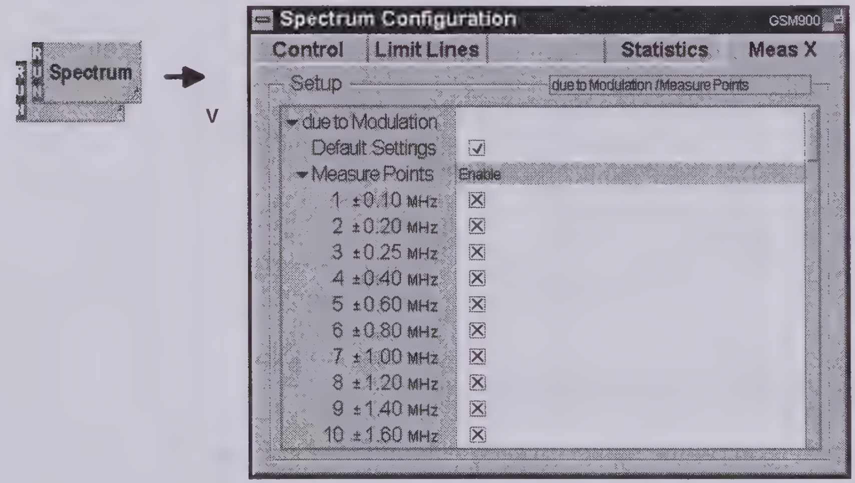
due to Modulation
Default Settings ☑
Number of Bursts 500
due to Switching
Default Settings ☑
Number of Bursts 10

Fig. 4-20 Spectrum Configuration – Limits

All settings can be defined separately for the two applications *due to Modulation* and *due to Switching.* They comply with those of the menu *Control* in the menu group *Power* (see page 4.12). In the remote-control commands, the keyword `POWer` is to be replaced by `SPECtrum:MODulation|SWITching`.

Selection of Measurement Points (Spectrum Configuration – Meas X)

The index card *Meas X* defines at which frequencies a *Spectrum* measurement is performed.


RUN
Spectrum
V
Spectrum Configuration
GSM900
Control
Limit Lines
Statistics
Meas X
Setup
due to Modulation / Measure Points

due to Modulation
Default Settings ☑
Measure Points Enable
1 ±0.10 MHz ☒
2 ±0.20 MHz ☒
3 ±0.25 MHz ☒
4 ±0.40 MHz ☒
5 ±0.60 MHz ☒
6 ±0.80 MHz ☒
7 ±1.00 MHz ☒
8 ±1.20 MHz ☒
9 ±1.40 MHz ☒
10 ±1.60 MHz ☒

Fig. 4-21 Spectrum Configuration – Meas X

All settings can be defined separately for the two applications *due to Modulation* and *due to Switching.*

Measure Points	The *Measure Points* table section enables (*Enable* box checked) or disables the spectrum measurement at individual frequency points. All frequencies listed in Table 4-1 (spectrum due to modulation) and Table 4-3 (spectrum due to switching) can be selected. A reduction of the measurement points enhances the measurement speed.

Remote control
```
CONFigure:SPECtrum:MODulation|SWITching:
             CONTrol:MPOint<nr>:ENABle ON|OFF
```

Popup Menu Connection Control

The menu group *Connection Control* consists of three popup menus which configure the inputs and outputs of the CMU and the respective signals in the function group *GSM900/1800/1900-MS Non Signalling.*

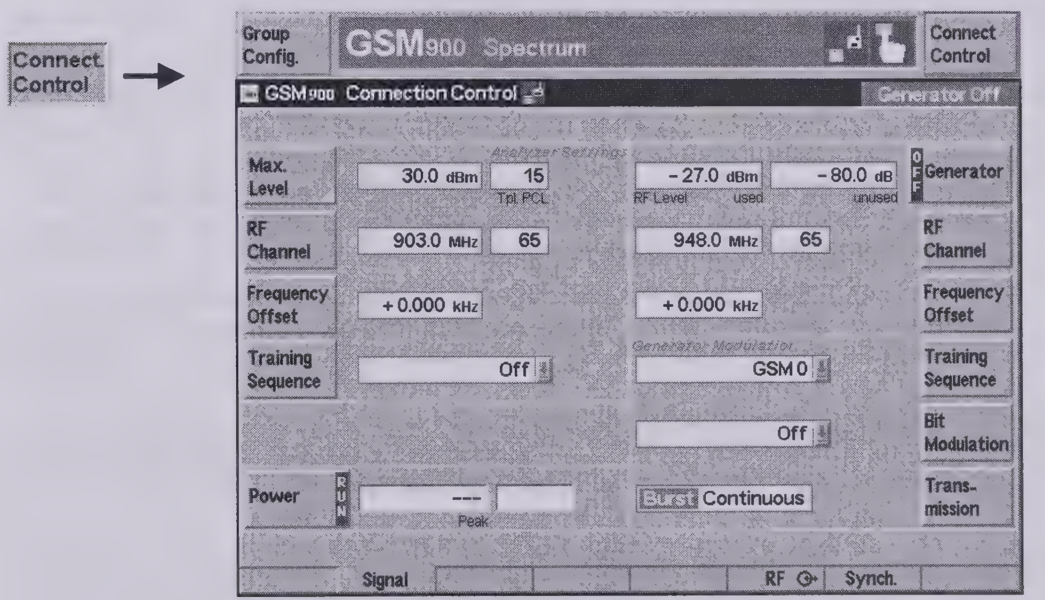
The menu group is activated via the softkey *Connect. Control* to the right of the header of each measurement menu. The individual index cards *(Signal, RF* ↔. and *Sync.)* are connected with each other via the hotkey bar at the lower edge of the screen.

Control of Input and Output Signals (Connection Control – Signal)

The popup menu *Signal* configures the RF signals generated by the RF generator of the CMU and those that can be measured by the instrument. Besides it controls the wide-band peak power measurement *(Power)* and indicates the result. In the three configuration panels, the following settings are possible:

- Maximum level *(Max. Level)*, channel *(RF Channel)*, *Frequency Offset*, and *Training Sequence* of the signals analyzed *(Analyzer Settings)*
- Level *(RF Level)*, channel *(RF Channel)*, and *Frequency Offset* of the signals generated *(RF Generator)*
- Bit modulation sequence *(Bit Modulation)*, *Training Sequence*, and type of *Transmission* of the signals generated *(Generator Modulation)*

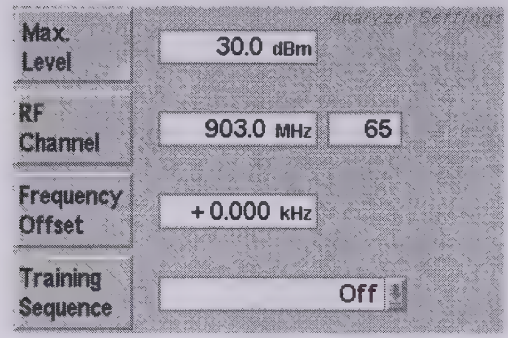
All setting values of this menu are also displayed in the main menu *Analyzer/Generator* (see page 4.2).


Connect Control
Group Config.
GSM900 Spectrum
Connect Control
GSM900 Connection Control
Generator Off
Analyzer Settings
Generator Modulation
Generator
OFF
RUN
Signal
RF ⊙→
Synch.

Max. Level: 30.0 dBm, 15 Tpl PCL; RF Level: -27.0 dBm used, -80.0 dB unused
RF Channel: 903.0 MHz, 65; 948.0 MHz, 65
Frequency Offset: +0.000 kHz; +0.000 kHz
Training Sequence: Off; GSM 0
Bit Modulation: Off
Power: --- Peak
Transmission: Burst Continuous

Fig. 4-22 Connection Control – Input and output signals

Panel Analyzer Settings



Analyzer Settings

Max. Level: 30.0 dBm

RF Channel: 903.0 MHz 65

Frequency Offset: +0.000 kHz

Training Sequence: Off

The panel *Analyzer Settings* contains four softkeys which specify

- The maximum level *(Max. Level)*
- The channel number or frequency *(RF Channel)*
- An additional *Frequency Offset*
- The *Training Sequence* of the signals measured by the CMU

Max. Level

The *Max. Level* softkey sets the input attenuator and thus limits the input level which can be measured by the CMU.

This parameter is identical with the maximum input level in the popup menu *Group Configuration* (see page 4.48). The range of values depends on the RF input used. If an external input attenuation is reported to the instrument (see section *AF/RF Connectors (Connection Control – AF/* on page 4.43), all levels measured are referred to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.

Input levels exceeding the *Max. Level* can not be measured; the corresponding measurement result fields indicate "– – –".

Remote control `[SENSe:]LEVel:MAXimum <Level>`

RF Channel

The *RF Channel* softkey defines the channel number or frequency of the measured signal.

The assignment of channel numbers and frequencies is defined in the GSM specification for both directions of transmission. Therefore, it is sufficient to enter only one value (frequency **or** channel number), the other one is automatically determined by the CMU.

The following tables contain the channel assignment in the uplink direction (i.e. from mobile to base station/CMU). Channel numbers which are not listed in the tables are not assigned.

Table 4-4 GSM channels in the uplink direction

Channel/frequency overview
GSM900

Frequency / [MHz]	Chan-nel	Band
0.2 876	--- ---	–
876.2 880	955 974	R-GSM band (European railway netw.)
880.2 889.8 890.0	975 1023 0	E-GSM band (extended GSM)
890.2 914.8	1 124	P-GSM-Band (primary GSM)
915 2700	---	–

Channel/frequency overview
GSM1800

Frequency / [MHz]	Chan-nel	Band
0.2 1710	--- ---	–
1710.2 1784.8	512 885	GSM 1800 band
1785 2700	--- ---	–

Channel/frequency overview
GSM1900

Frequency / [MHz]	Chan-nel	Band
0.2 1850	--- ---	–
1850.2 1909.8	512 810	GSM 1900 band
1910 2700	--- ---	–

According to the channel width of the three GSM bands, the RF frequency can be set in multiples of 200 kHz. It can be modified by an additional *frequency offset* entered in the input field below.

Remote control `[SENSe:]RFANalyzer:CHANnel <Number>`

Frequency Offset

The *Frequency Offset* softkey defines an offset shifting the frequency set under *RF Channel*.

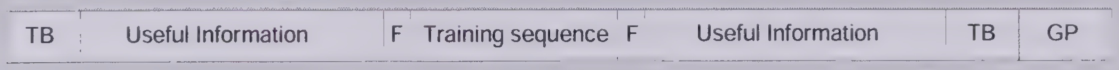
This enables fine tuning of the frequency measured by the CMU, e.g. in order to simulate a Doppler shift (caused by a relative movement between mobile and base station) or detuning of the mobile.

Remote control `[SENSe:]RFANalyzer:FREQuency:OFFSet <Number>`

Training Sequence

The *Training Sequence* softkey defines a training sequence for the measured signal.

The training sequence is located in the middle of the symmetrical normal burst and is used for synchronization and to assess the transmission conditions in the RF channel.



TB	Tail bits (end or start bit)	Bits 0 to 2, 145 to 147
Useful information		Bits 3 to 59, 88 to 144
F	Flag Bit, Stealing Flag	Bits 60, 87
Training sequence		Bits 61 to 86
GP	Guard Period, transmission-free time of 8.25 bit periods	

Fig. 4-23 Bit structure of a GSM normal burst

Here the training sequence is used to distinguish different burst types: If a definite training sequence is specified, the CMU only analyzes bursts with this training sequence. The following settings are provided:

GSM 0 to 7	GSM standard training sequences
Dummy	GSM-specific dummy burst

Off Measurement of all bursts regardless of their training sequence

GSM training sequences The 8 standard training sequences *GSM 0 to GSM 7* are specified in the GSM standard and read as follows:

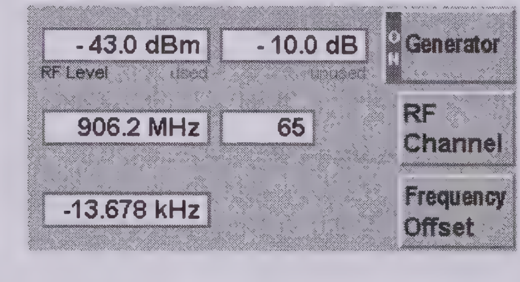
TSC	Bit pattern (Bits No. 61 to 86)																									
0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	1
1	0	0	1	0	1	1	0	1	1	1	0	1	1	1	1	0	0	0	1	0	1	1	0	1	1	1
2	0	1	0	0	0	0	1	1	1	0	1	1	1	0	1	0	0	1	0	0	0	0	1	1	1	0
3	0	1	0	0	0	1	1	1	1	0	1	1	0	1	0	0	0	1	0	0	0	1	1	1	1	0
4	0	0	0	1	1	0	1	0	1	1	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	1
5	0	1	0	0	1	1	1	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0
6	1	0	1	0	0	1	1	1	1	1	0	1	1	0	0	0	1	0	1	0	0	1	1	1	1	1
7	1	1	1	0	1	1	1	1	0	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	0	0

TSC	training sequence code for numbering the sequences
Bit pattern	26-bit training sequence

Note: *In Signalling Mode, no training sequence but signalling parameters such as the color code of the base station can be specified for analyzed signals. This also serves to search for bursts with a particular characteristic.*

Remote control `[SENSe:]RFANalyzer:TSEQuence <Number>`

RF Generator Panel



The *RF Generator* panel combines three softkeys which define

- the maximum level for the used and unused timeslot (main softkey *RF Generator*)
- the channel number or frequency *(RF Channel)*
- a freely selectable frequency offset *(Freq. Offset)* for the signals generated by the RF generator

Generator The softkey *Generator* defines the generator level and indicates the operating status of the RF generator *(ON / OFF)*.

For the generator level, a distinction is made between the used timeslot (selected and used for later measurements) and the remaining, unused timeslots. This feature is useful for many tests specified by GSM. E.g. in the "Adjacent Timeslot Rejection" test the adjacent time slot level is set to a higher value than the used time slot level in order to test whether the mobile receiver can quickly adapt to fast level changes.

Remote control
```
INITiate:RFGenerator
ABORt:RFGenerator
FETCh:RFGenerator:STATus?
```

Used The level is indicated as absolute value (in dBm).

Remote control `SOURce:RFGenerator:LEVel:UTIMeslot <Level>`

Unused

The level is indicated relative to the level in the used timeslot (in dB). The absolute level in the unused timeslots, i.e. the sum of numerical values set under *used* and *unused* must lie within the permissible range for the RF outputs. This condition further restricts the permissible level for the unused timeslots.

External attenuation

If an external gain or attenuation is used and reported to the instrument (see softkey *Ext. Att. Output*) the RF generator level is adjusted to maintain the commanded power after the attenuation or gain. As a consequence, all levels indicated are referred to the input of the DUT and no longer correspond to the actual level at the output connectors of the CMU (see section *AF/RF Connectors (Connection Control – AF/* on page 4.43). The default value for the generator power is also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.

Error messages

If the level defined for *RF Level* is too high or too low, a window will appear with the error message *"<RF_Level> is out of range. <Permissible max. value> is limit.*" and three fields:

Accept	Permissible max. value is accepted as *Max. Level*,
Re-edit	The *Max. Level* is entered once again,
Cancel	The last valid input is maintained.

When switching over to a different output, the current value of *Max. Level* is automatically adapted, if required:

- towards lower values to the maximum permissible value of the new output,
- towards higher values to the minimum value of the new output.

Remote control

`SOURce:RFGenerator:LEVel:UNTimeslot <Level>`

RF Channel

The *RF Channel* softkey defines the channel number or the frequency of the generated RF signal.

The assignment of channel numbers and frequencies is unambiguously defined in the GSM specification for both directions of transmission. Therefore, it is sufficient to enter only one value (frequency **or** channel number), the other one is automatically determined by the CMU.

The following tables contain the channel assignment in the downlink direction (i.e. from base station/CMU to mobile). The channel frequencies are shifted by +45 MHz compared with the uplink (duplex spacing, see above, *Panel Analyzer Settings*): Channel numbers which are not listed in the tables are not assigned.

Table 4-5 GSM channels in the downlink direction

Channel/frequency overview GSM900

Frequency / [MHz]	Chan- nel	Band
0.2 921	--- ---	–
921.2 925	955 974	R-GSM band (European railway netw.)
925.2 934.8 935.0	975 1023 0	E-GSM band (extended GSM)
935.2 959.8	1 124	P-GSM-Band (primary GSM)
960 2700	--- ---	–

Channel/frequency overview GSM1800

Frequency / [MHz]	Chan- nel	Band
0.2 1805	--- ---	–
1805.2 1879.8	512 885	GSM 1800 band
1880 2700	--- ---	–

Channel/frequency overview GSM1900

Frequency / [MHz]	Chan- nel	Band
0.2 1930	--- ---	–
1930.2 1989.8	512 810	GSM 1900 band
1990 2700	--- ---	–

Remote control `SOURce:RFGenerator:FREQuency:CHANnel <Number>`

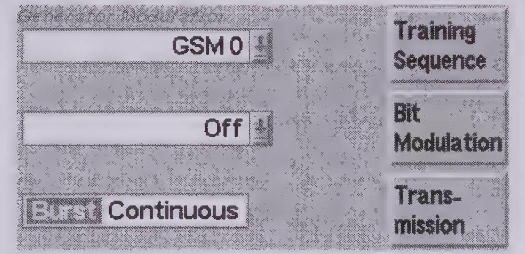
Frequency Offset

The *Freq. Offset* softkey defines a frequency offsetshifting the frequency set under RF Channel.

This enables fine tuning of the RF frequency generated by the CMU, e.g. in order to simulate a Doppler shift (caused by a relative movement between mobile and CMU) or detuning of the mobile.

Remote control `SOURce:RFGenerator:FM:DEViation <FrequencyOffset>`

Generator Modulation Panel



The *Generator Modulation* panel combines three softkeys which

- Select a *Training Sequence*
- Define a *Bit Modulation* sequence for the generated RF signals
- Define the *Transmission* mode (continuous or burst signal)

Training Sequence

The *Training Sequence* softkey defines the training sequence that is superimposed on the RF carrier signal.

The following settings are possible:

GSM 0 to 7	GSM standard training sequences
Dummy	GSM-specific dummy burst
Off	No training sequence defined

The 8 GSM standard training sequences are listed above (*Analyzer Settings* Panel on page 4.38).

Remote control

```
CONFigure:RFGenerator:MODulation:TSEQuence:SELection
                                 OFF | GSM0 | ... | GSM7 | DUMMy
```

Bit Modulation

The *Bit Modulation* softkey defines a bit sequence that is modulated onto the RF carrier signal.

The following types of modulation sequence can be selected:

Off	No signal superimposed, "empty" carrier
PRBS	Pseudo random bit sequence
Dummy Bursts	Fixed bit sequences (Dummy Bursts) with selectable training sequence, see next softkey

Remote control

```
CONFigure:RFGenerator:MODulation:BIT:SELection
  OFF | PRBS | DUMMyburst
```

Trans-mission

The softkey *Transmission* determines the shape of the generated RF signal.

The RF generator generates either a burst or a continuous signal, i.e. a carrier with a constant level.

Remote control

```
CONFigure:RFGenerator:MODulation:TRANsmission
                       BURSt | CONTinuous
```

Wide-Band Power

Power

The *Power* softkey controls the wide-band power measurement and indicates its state *(RUN | HLT | OFF).*

The state can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The measurement result in units of dBm and the relative progress of the measurement is indicated in the output fields to the right of the softkey.

The result of the wide-band power measurement is usually slightly higher than the result of the *Power vs Time* measurement which is obtained with different filter characteristics.

Remote control

```
INITiate:SPOWer
FETCh:SPOWer:STATus?
READ[:SCALar]:SPOWer[:RESult]?
FETCh[:SCALar]:SPOWer[:RESult]?
SAMPle[:SCALar]:SPOWer[:RESult]?
```

AF/RF Connectors (Connection Control – AF/RF)

The popup menu *AF/RF* ↔ (function group *GSM900/1800/1900-MS*, *Non Signalling* or *Signalling* mode) configures the connectors for RF signals. This includes the setting of

- The RF input and output of the CMU *(RF Output, RF Input)*
- An external attenuation at the connectors *(Ext. Att. Output, Ext. Att. Input)*
- The input source of the CMU speech encoder and the output destination of its speech decoder

If the *Audio Generator and Analyzer* (option CMU-B41) is not fitted, the speech codec (option CMU-B52) is connected to the 9-pole *SPEECH* (handset) connector on the CMU front panel, see chapter 8 of the CMU200 operating manual.

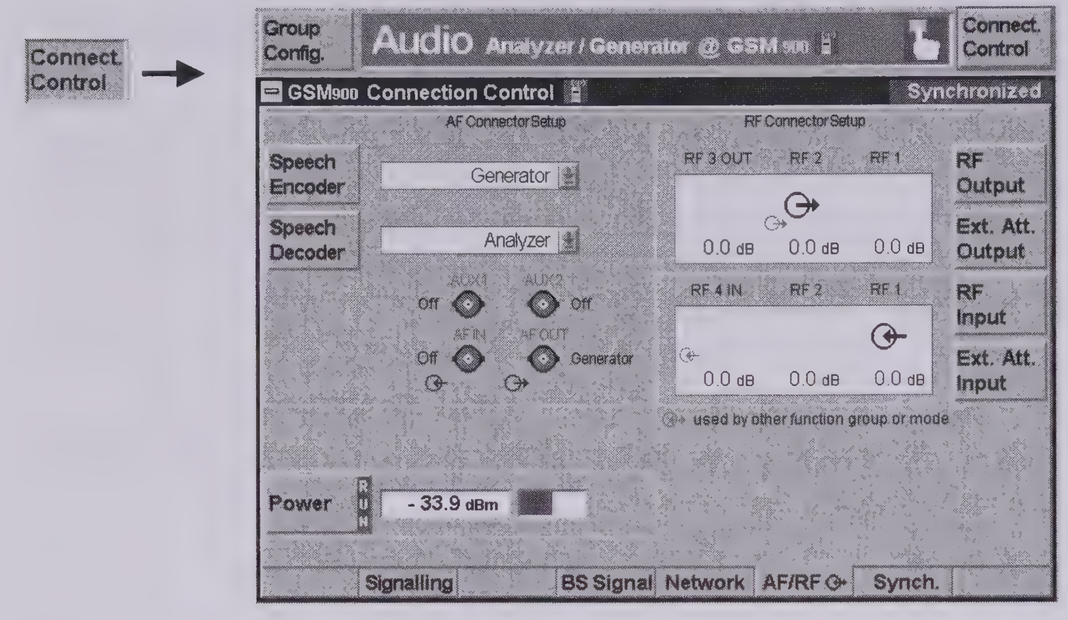

Connect. Control
Group Config.
Audio Analyzer / Generator @ GSM900
Connect. Control
GSM900 Connection Control
Synchronized
AF Connector Setup
RF Connector Setup
Speech Encoder
Generator
Speech Decoder
Analyzer
AUX1
AUX2
Off
Off
AF IN
AF OUT
Off
Generator
RF 3 OUT
RF 2
RF 1
0.0 dB
0.0 dB
0.0 dB
RF 4 IN
RF 2
RF 1
0.0 dB
0.0 dB
0.0 dB
used by other function group or mode
RF Output
Ext. Att. Output
RF Input
Ext. Att. Input
Power
RUN
- 33.9 dBm
Signalling
BS Signal
Network
AF/RF
Synch.

Fig. 4-24 Connection Control – AF/RF connectors

The *Power* measurement is explained in section *Wide-Band Power* on page 4.43.

Speech Encoder

The *Speech Encoder* softkey selects the input source for the CMU speech encoder (option CMU-B52).

The following three input sources are available:

Generator	Use the audio generator signal which is also fed to the *AF OUT* connector on the CMU front panel
AUX 1	Use the signal fed in via the *AUX 1* connector on the CMU front panel
Handset	Use the signal of the 9-pole *SPEECH* (handset) connector on the CMU front panel

Remote control `ROUTe:SPENcoder[:INPut] HANDset | GENerator | AUX1`

Speech Decoder

The *Speech Decoder* softkey selects the output destination for the CMU speech decoder (option CMU-B52).

The following three output destinations are available:

Analyzer	Route speech decoder output to audio analyzer. The standard analyzer input socket *AF IN* is disabled *(Off).*
AUX 2	Route speech decoder output to the *AUX 2* connector on the CMU front panel
Handset	Route speech decoder output to the 9-pole *SPEECH* (handset) connector on the CMU front panel

Remote control `ROUTe:SPDecoder[:OUTPut] HANDset | ANALyzer | AUX2`

RF Output

The *RF Output* softkey defines which of the three connectors RF 1, RF 2 and RF 3 OUT is to be used as RF output connector.

A symbol ⊖→ indicates the selected RF output.

Note: *Input and output connectors can be arbitrarily combined. The bidirectional connectors RF 1 and RF 2 can be selected as RF inputs* *and outputs at the same time.*

The LEDs on the front panel are only „on" (light) if the output level is switched on.

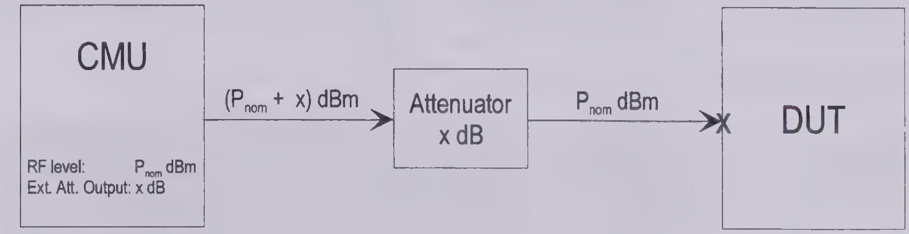
Remote control `OUTPut[:STATe] RF1 | RF2 | RF3`

Ext. Att. Output

The softkey *Ext. Att. Output* defines an external attenuation (or gain, if the value is negative) at the selected RF output.

Input of an external attenuation is suitable if, for example, if a path attenuation (cable) is included in the test setup, which is to be corrected by an increased signal level.

If an external attenuation is defined, the output signal level is referred to the input of the DUT, the generator level is therefore shifted with respect to the actual level at the input connector of the CMU. The default value for the generator power and the level ranges for the RF outputs are also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.



Remote control `[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]`
`SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]`

RF Input

The *RF Input* softkey determines which of the three connectors RF 1, RF 2 and RF 4 IN is to be used as RF input connector.

If a connector is selected as RF input, a symbol ⊙ will appear in the respective field. Input and output connectors can be arbitrarily combined.

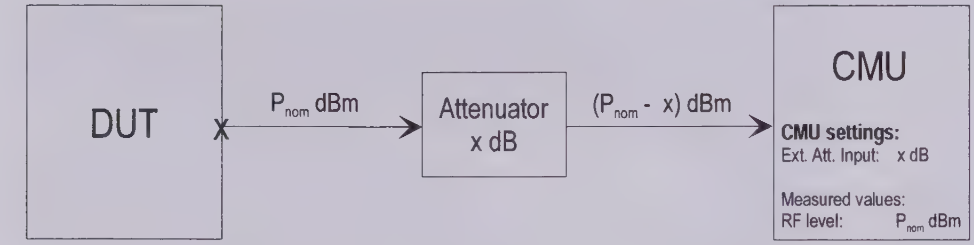
Remote control `INPut[:STATe] RF1 | RF2 | RF4`

Ext. Att. Input

The softkey *Ext. Att. Input* enters the value of the external attenuation (or gain) at the selected RF input.

Input of an external attenuation is required if, for example, external attenuator pads are used for protection of the sensitive RF inputs of the CMU or if a path attenuation is included in the test setup.

If an external input attenuation is reported to the instrument (see section *AF/RF Connectors (Connection Control – AF/* on page 4.43), all levels measured are referred to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.


DUT
P_{nom} dBm
Attenuator
x dB
(P_{nom} - x) dBm
CMU
CMU settings:
Ext. Att. Input: x dB
Measured values:
RF level: P_{nom} dBm

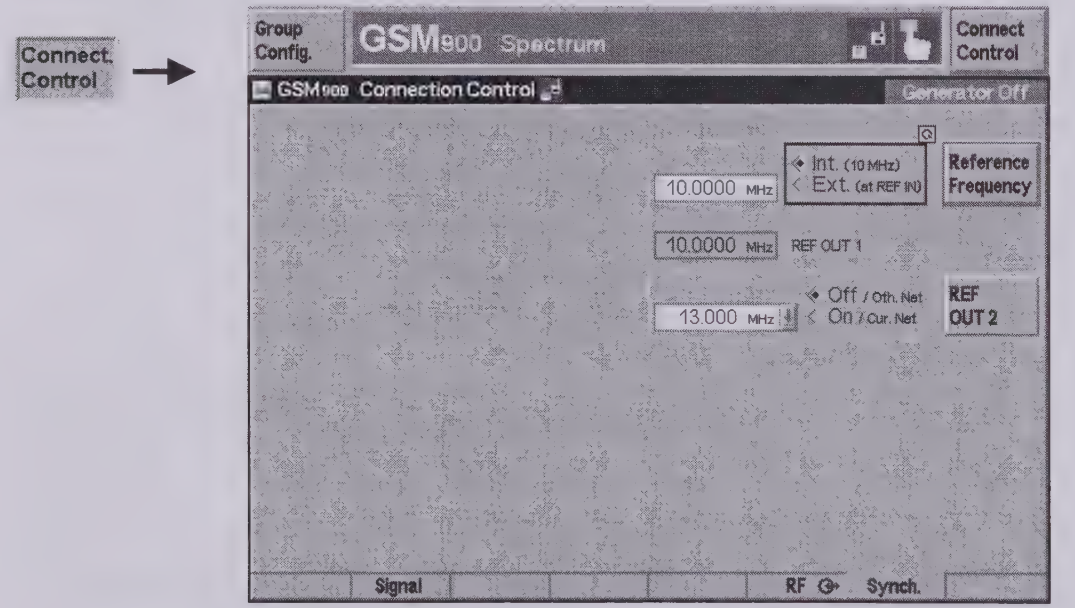
Note: *The LEDs on the front panel are only "on" (light) if the measurement is active.*

Remote control
`[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]`
`SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude]`

Reference Frequency (Connection Control – Synch.)

The popup menu *Synch.* defines the reference signals for synchronization. This includes

- the internal or external *Reference Frequency*,
- the output mode for the network-specific system clock *(REF OUT 2)*.


Connect. Control
Group Config.
GSM900 Spectrum
Connect Control
GSM900 Connection Control
Generator Off
Reference Frequency
REF OUT 2
Signal
RF
Synch.

◆ Int. (10 MHz)
‹ Ext. (at REF IN) 10.0000 MHz

10.0000 MHz REF OUT 1

◆ Off / Oth. Net
‹ On / Cur. Net 13.000 MHz

Fig. 4-25 Connection Control – Synchronization

Reference Frequency

The *Reference Frequency* softkey determines the source and the frequency of the reference signal.

The associated field permits to select between two alternatives:

Int. (10 MHz)	Internal synchronization with 10 MHz (TCXO or OCXO, CMU-B11/-B12) applied to output REF OUT 1 at the rear of the instrument.
Ext. (at REF IN)	External reference signal to be fed in via input *REF IN* and applied to output REF OUT 1 at the rear of the instrument.

The frequency of the external reference signal must be entered in the input field next to the *External* button.

The reference signal used is applied to output *REF OUT 1* so that it can be fed to other instruments as well. It can be used for synchronization to another instrument.

Notes:

1. *With external synchronization selected, the header cyclically displays a warning if no synchronization has been performed e.g. because of missing or faulty input signal.*
2. *In the case of external synchronization with squarewave signals (TTL) ensure correct signal matching to avoid reflections. Otherwise, resulting overshoots may cause trigger problems at the CMU input. A possible remedy is to use a lowpass filter or an attenuator pad directly at the CMU input. Correct synchronization may be checked by comparing the signal REF OUT 1 or REF OUT 2 with the input signal.*

Remote control

```
CONFigure:SYNChronize:FREQuency:REFerence:MODE <ON | OFF>
CONFigure:SYNChronize:FREQuency:REFerence <Frequency>
```

REF OUT 2

The softkey *REF OUT 2* configures a network-specific system clock REF OUT 2 to be fed to the output *REF OUT 2* at the rear of the instrument.

The associated field permits to select between two alternatives:

OFF (other network)	The clock frequency of the current function group is not fed to the output *REF OUT 2*. With this setting the system clock of another active function group (e.g. the network GSM1800 while the current network is GSM900) is still applied to *REF OUT 2* provided that the output *REF OUT 2* is switched on in the other function group. However, if *REF OUT 2* is explicitly switched over from *On* to *Off* the clock signal is definitely removed.
On (current network)	The network-specific system clock of the current function group is fed to output REF OUT 2. The system clock of any other function group applied to REF OUT 2 before is replaced.

Besides the basic clock frequency of 39 MHz one of the following clock frequencies may be selected:

39.000 MHz, 19.500 MHz, 13.000 MHz, 9.750 MHz, 7.800 MHz, 6.500 MHz, 5.571 MHz,
4.875 MHz, 4.333 MHz, 3.900 MHz, 3.545 MHz, 3.250 MHz, 3.000 MHz, 2.786 MHz,
2.600 MHz, 2.438 MHz, 2.294 MHz, 2.166 MHz, 2.053 MHz, 1.950 MHz, 1.857 MHz,
1.773 MHz, 1.696 MHz, 1.625 MHz, 1.560 MHz, 1.500 MHz, 1.444 MHz, 1.393 MHz,
1.349 MHz, 1.300 MHz, 1.258 MHz, 1.219 MHz

(The values are calculated according to the formula $F_{out} = 39.000\ MHz / n$ where $n = 1, \dots, 32$.)

The clock frequency can be used to synchronize other instruments.

Remote control

```
SOURce:DM:CLOCk:STATe ON | OFF
SOURce:DM:CLOCk:FREQuency <Frequency>
```

Popup Menu Group Configuration

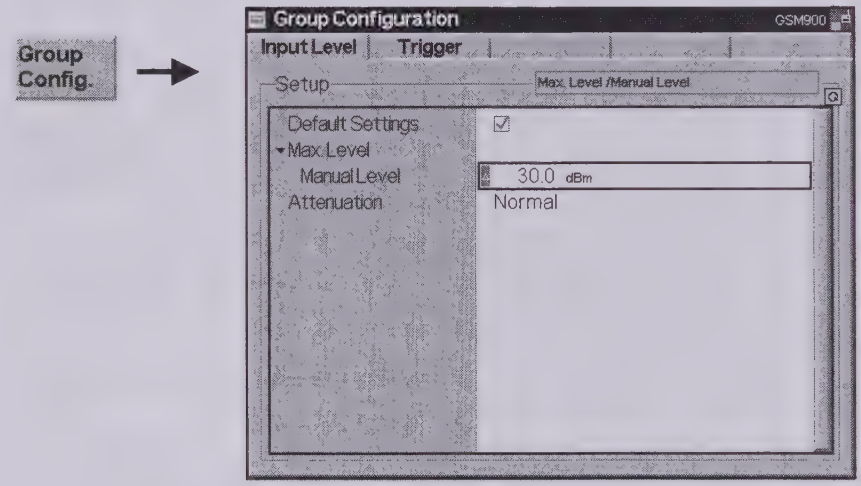
The popup menu *Group Configuration* contains four index cards which configure the measurements in the function group GSM900/1800/1900-MS globally, i.e. for all subsequent measurement menus. Most of the settings made here can be changed for a single measurement, if required, directly in the graphical measurement menu using softkeys and popup input fields.

The popup menu *Group Configuration* can be activated by pressing the softkey *Group Config.* at the top left in each measurement menu. It is possible to change between the index cards by pressing the associated hotkeys.

Input Level (Group Configuration – Input Level)

The index card *Input Level* provides settings for the measured input level (see also section *Connection Control* on page 4.37):

- Maximum expected input level from the DUT *(Max. Level)*
- Attenuation or gain *(Attenuation)*



Default Settings ☑
Max. Level
Manual Level 30.0 dBm
Attenuation Normal

Fig. 4-26 Group Configuration – Input level

Default	The field *Default* assigns the default setting to all fields of the index card *Input Level.*
Remote control	`[SENSe:]LEVel:DEFault ON | OFF`
Max. Level	The *Max. Level* field sets the input attenuator and thus determines the maximum input level which can be measured. The maximum input level is displayed next to the softkey *Max. Level* in the main menu *Analyzer/Generator* (see page 4.2). *Manual* Manual input of maximum expected input level
Remote control	`[SENSe:]LEVel:MAXimum <Level>`

External attenuation

The range of values depends on the RF input used. If an external input attenuation is reported to the instrument (see section *AF/RF Connectors (Connection Control – AF/* on page 4.43), all levels measured are referred to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.

Input levels exceeding the *Max. Level* can not be measured; the corresponding measurement result fields indicate "– – –".

Error messages

If the value determined for *Max. Level* is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit."* and three fields will appear:

Accept	The permissible max. value is accepted as Max. Level
Re-edit	Max. Level is entered once again
Cancel	The last valid input value is maintained

When switching over to another input, the current value of *Max. Level* is automatically adapted, if required:

- towards lower values to the maximum permissible value of the new input,
- towards upper values to the minimum value of the new input.

Remote control `[SENSe:]LEVel:MAXimum <Level>`

Attenuation

The *Attenuation* field determines an attenuation or gain factor for the input signal on the RF side.

Normal	mixer level in normal range,
Low noise	mixer level higher by +10 dB (full dynamic range of CMU),
Low distortion	mixer level lower by –10 dB (high intermodulation reserve).

The setting of *Attenuation* permits the CMU to be adapted to the requirements of the current measurement. The advantages and disadvantages of the settings *Low noise* and *Low distortion* are listed in the following table.

	Advantages	Disadvantages
Low noise	Low noise high dynamic range	No RF overdrive reserve Risk of intermodulation
Low distortion	High intermodulation spacing	Lower dynamic range

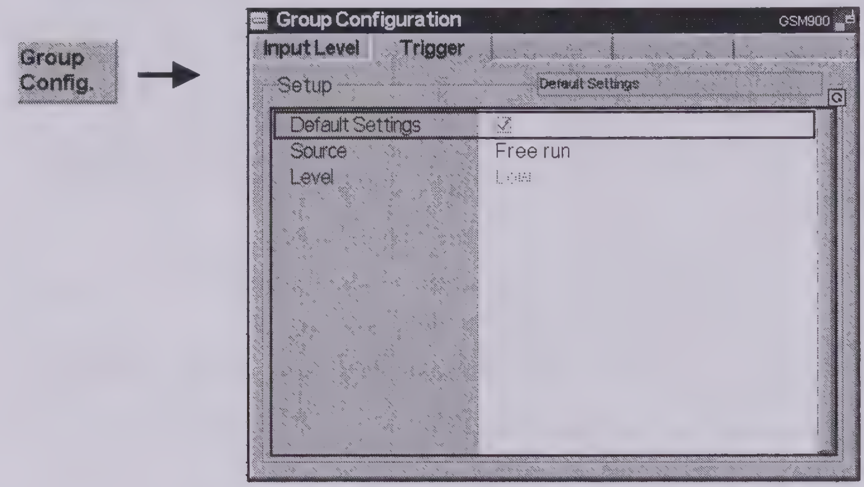
External attenuation

An external input attenuation reported to the CMU (see softkey *Ext. Att. Input* in the menu *Connector/Ext. Att.* on page 4.43) is taken into account for all power measurement results and for the internal power settings. As a consequence, the range of input levels is shifted.

Remote control `[SENSe:]LEVel:ATTenuation <Mode>`

Trigger (Group Configuration – Trigger)

The index card *Trigger* defines the trigger condition for the measurement.



Default Settings ☑
Source Free run
Level Low

Fig. 4-27 Group Configuration – Trigger

Default The field *Default* assigns the default setting to all fields of the index card *Trigger*.

Remote control `TRIGger[:SEQuence]:DEFault ON | OFF`

Source The *Source* field determines how the measurement is to be triggered:

Free Run	Triggering via TDMA timing (synchronization information in the training sequence)
RF Power	Triggering on the power (rising edge) of the incoming burst, broad-band trigger
IF Power	Narrow-band trigger
Extern	External trigger signal fed in via connector AUX3 (pin no. 8)

For the *RF Power* and *IF Power* parameters the signal to be measured must be a burst signal.

The external trigger can be selected for all *Non Signalling* measurements. In contrast, *Signalling* measurements must be triggered by the signal from the signalling unit or from the mobile phone.

Remote control

```
TRIGger[:SEQuence]:SOURce
            IMMediate | RFPOWer | IFPOWer | EXTern
```

Level The *Level* field determines the trigger threshold if the measurement is triggered by the *RF Power* or *IF Power*.

The trigger threshold is the level at which the trigger signal starts triggering. With free-run measurements or external trigger the *Trigger Level* field is disabled.

Low	low trigger level equal to the reference level –26 dB
Medium	medium trigger level equal to the reference level –16 dB
High	high trigger level equal to the reference level –6 dB

Remote control `TRIGger[:SEQuence]:THReshold LOW | MEDium | HIGH`

GSM Measurements with Signalling

The structure of this section is based on the configuration and measurement groups defined in function group *GSM900/1800/1900-MS Signalling*, i.e. on the menus of the graphical user surface. The menus are dealt with in the order of their operation:

1. Call setup to the mobile station *(Connection Control – Signal)*
2. Overview of measurements and global settings *(Overview)*
3. Measurement menus *(Power, Modulation, Sensitivity):* performance of the measurements, output of the measurement results, specific measurement configurations
4. General device configurations *(Connection Control, Group Configuration)*

A lot of menus and controls are identical in the two operating modes for *GSM900/1800/1900-MS* with and without signalling. In this chapter, these menus will only be presented with a summary explanation; the detailed description can be found in the section *GSM900/1800/1900-MS Non Signalling*.

Call Setup (Popup Menu Connection Control – Signalling)

The menu group *Connection Control* controls the signalling (call setup and release, services, signalling parameters) and configures the inputs and outputs with the external attenuation values and the reference frequency.

As the measurement mode requires an existing connection to the mobile station, the menus for setting up the call (*Connection Control – Signalling)* appear immediately after selection of the function group and mode *GSM900/1800/1900-MS Signalling* in the *Menu Select* menu. Besides, all the menus of the group *Connection Control* can be activated by pressing the softkey *Connect. Control* at the top right in every measurement menu and are linked with each other via the hotkey bar at the lower edge of the screen. By pressing the *Escape* key, the active *Connection Control* menu is closed and the CMU changes to the measurement mode.

In the following the first three index cards *Connection Control – Signalling* displayed during the call setup are described. The other index cards of the *Connection Control* menu are relegated to the end of this chapter (see section *Signalling Control with Call Established* on page 4.87).

The term signalling summarizes all procedures that are necessary for call setup and release and for control of a connection in the mobile radio network. In the case of the CMU, a distinction is made between four different signalling states:

• Signal Off	CMU transmits no signal
• Signal On	CMU outputs a GSM control channel signal to which a mobile station can synchronize
• Synchronized	Synchronization with the mobile station and location update performed
• Call Established	Call to mobile station established

A number of control commands which can be initiated both by the CMU *(Call to MS)* and by the mobile station *(Call from MS)* switch between these states (in Fig. 4-1, processes initiated by the mobile station are indicated by dashed lines).

A lot of applications within the function group *GSM900/1800/1900-MS Signalling* are only possible or useful in a particular signalling state (for example, handover between various networks requires an existing connection between CMU and mobile station, i.e. it is only possible in the *Call Established* state). Accordingly, the possible functions of menus vary depending on the present signalling state.

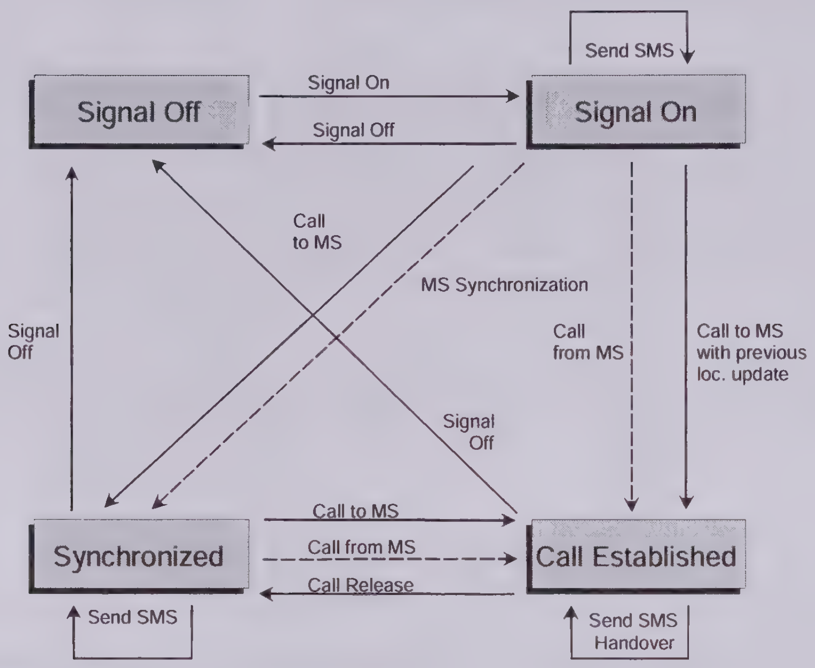

Send SMS
Signal Off
Signal On
Signal On
Signal Off
Call
to MS
MS Synchronization
Signal
Off
Call
from MS
Call to MS
with previous
loc. update
Signal
Off
Call to MS
Call from MS
Call Release
Synchronized
Call Established
Send SMS
Send SMS
Handover

Fig. 4-28 Signalling states of the CMU

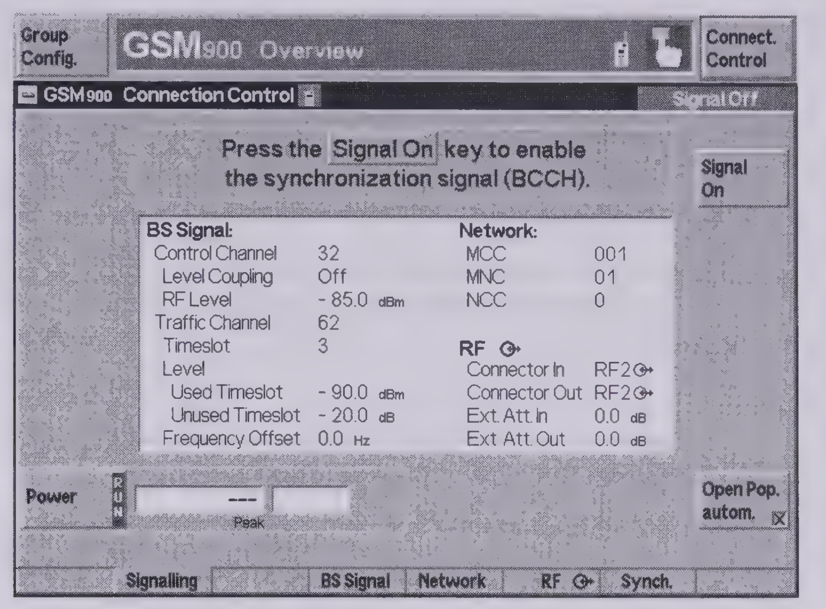
Corresponding to the four possible signalling states, four different *Signalling* menus are available. When a signalling state is reached, the corresponding menu is opened automatically (exception: see softkey *Open Pop. autom.*).

Signalling Control without Signal (State Signal Off)

The popup menu *Signalling (Signal Off)* provides information on:

- The most important parameters characterizing the frequency and level of the signal sent by the CMU in the state *Signal On (BS Signal)*
- The code of the *Network*
- Selected AF and RF connectors and external attenuation *(AF/RF ⊖)*
- Status and result of wide-band peak power measurement *(Power)*
- Besides, it activates the control channel signal for the call setup to the mobile station *(Signal On)*.

Connect. Control →



Press the Signal On key to enable the synchronization signal (BCCH).

BS Signal:		Network:	
Control Channel	32	MCC	001
Level Coupling	Off	MNC	01
RF Level	- 85.0 dBm	NCC	0
Traffic Channel	62		
Timeslot	3	RF	
Level		Connector In	RF2
Used Timeslot	- 90.0 dBm	Connector Out	RF2
Unused Timeslot	- 20.0 dB	Ext. Att. In	0.0 dB
Frequency Offset	0.0 Hz	Ext. Att. Out	0.0 dB

Power ---

Fig. 4-29 Connection Control – Signalling (Signal Off)

Header Message A Header Message (here: *Press the Signal On key to enable the synchronization signal (BCCH))* displayed on top of each *Signalling* index card informs on the current instrument state or indicates how to proceed to get to other signalling states.

BS Signal The table *BS Signal* indicates the most important parameters with respect to frequency and level of the signal sent by the CMU in the state *Signal On*. These parameters are set in the index card *BS Signal* and explained in greater detail there (see section *Signals of the CMU (Connection Control – BS Signal)* on page 4.92).

Remote control `CONFigure:BSSignal...`

Network The table *Network* indicates the international network code *(MCC: mobile country code, MNC: mobile network code, NCC: network color code)*. This code is set in the index card *Network* and is explained there in greater detail (see section *Network Parameters (Connection Control – Network)* on page 4.96).

Remote control `CONFigure:NETWork...`

AF/RF → The table *AF/RF →* indicates the RF connectors and external attenuations. These parameters are set in the index card AF/*RF →* and are explained in greater detail there (see section AF/*RF Connectors (Connection Control – AF/RF Input/Output.)* on page 4.43).

Remote control `[SENSe:]CORRection:LOSS...?`

Power

The *Power* softkey controls the wide-band power measurement and indicates its state *(RUN | OFF | HLT)*.

The state can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The measurement result in units of dBm and the relative progress of the measurement is indicated in the output fields to the right of the softkey.

The result of the wide-band power measurement is usually slightly higher than the result of the *Power vs Time* measurement which is obtained with different filter characteristics.

Remote control

```
INITiate:SPOWer
FETCh:SPOWer:STATus?
READ[:SCALar]:SPOWer[:RESult]?
FETCh[:SCALar]:SPOWer[:RESult]?
SAMPle[:SCALar]:SPOWer[:RESult]?
```

Signal On

The *Signal On* softkey switches on a control channel signal to which the mobile station can synchronize.

By switching on the signal, the CMU changes to the signalling state *Signal On*. A user prompt below the header indicates the function of this softkey.

Remote control `PROCedure:SIGNalling:ACTion SON`

Open Pop. autom. ☐

The *Open Pop. autom.* softkey contains a field which activates or suppresses display of the popup menu *Signalling (Signal Off).*

- In the default setting (*Open Pop. autom.* on), the popup menu is displayed each time the *Signal Off* state is reached (due to a change of the signalling state or of the function group).
- In the alternative setting (*Open Pop. autom.* off), the popup-menu is suppressed. Signalling may still be controlled, e.g., from the mobile. Moreover, the popup menu *Signalling (Signal Off)* can also be opened explicitly by pressing the corresponding hotkey in the menu group *Connection Control.*

Remote control –

Signalling Control with Signal (State Signal On)

The popup menu *Signalling (Signal On)* provides information on

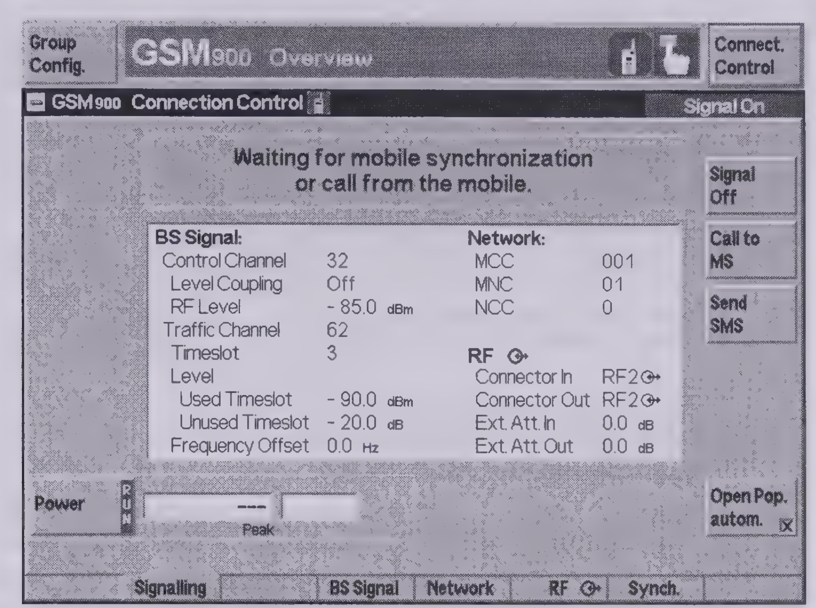
- The signal transmitted by the CMU *(BS Signal)*
- The network parameters *(Network)*
- The AF and RF connectors *(AF/RF⊸)*
- The status and result of the peak power measurement *(Power)*

Besides, it contains softkeys which lead to other signalling states:

- Switch off the control channel synchronization signal *(Signal Off),*
- Perform a location update or establish a call to the mobile station if a location update was already performed (*Call to MS* state *Synchronized* or *Call Established),*
- Short message service (*Send SMS* return to state *Signal On).*

The popup menu *Signalling (Signal On)* is opened after activation of the signal on the CMU (Softkey *Signal On* in the popup menu *Signalling (Signal Off)*). It is replaced by the *Signalling (Synchronized)* menu if the mobile station synchronizes to the CMU signal or if a location update is initiated via the *Call to MS* softkey. It is replaced by the *Signalling (Call Established)* menu if the mobile station sets up a call to the CMU or if a mobile that already performed a location update is called via the *Call to MS* softkey.

Connect. Control →



Waiting for mobile synchronization or call from the mobile.

BS Signal:
Control Channel 32
Level Coupling Off
RF Level - 85.0 dBm
Traffic Channel 62
Timeslot 3
Level
Used Timeslot - 90.0 dBm
Unused Timeslot - 20.0 dB
Frequency Offset 0.0 Hz

Network:
MCC 001
MNC 01
NCC 0

RF
Connector In RF2
Connector Out RF2
Ext. Att. In 0.0 dB
Ext. Att. Out 0.0 dB

Fig. 4-30 Connection Control – Signalling (Signal On)

The information in the output field (tables *BS Signal, Network,* and *AF/RF* →) and the *Power* softkey is described in section *Signalling Control without Signal (State Signal Off)* on page 4.52.

Header Message A Header Message (here: *Waiting for mobile synchronization or call from the mobile)* displayed on top of each *Signalling* index card informs on the current instrument state or indicates how to proceed to get to other signalling states.

Signal Off

The *Signal Off* softkey switches off the CMU's control channel signal to which the mobile station can synchronize.

The CMU changes to the signalling state *Signal Off.*

Remote control `PROCedure:SIGNalling:ACTion SOFF`

Call to MS

The *Call to MS* softkey sets up a call to the mobile station.

The header message indicates that the mobile station is to synchronize to the CMU signal first.

The function of the *Call to MS* softkey depends on the state of the connected mobile:

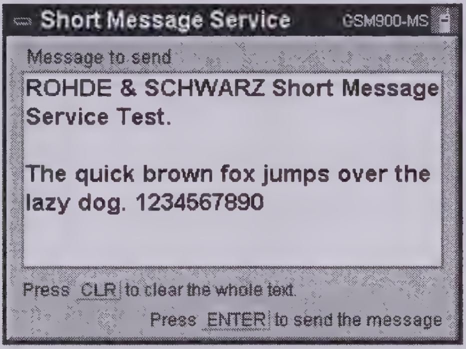
- If no location update has been performed yet (e.g. because the mobile was just switched on), the two successive messages *Paging in progress ... Location update in progress* are displayed below the header. The CMU changes to the signalling state *Synchronized.*
- If a location update was already performed, the two successive messages *Paging in progress ... Call to mobile in progress* are displayed below the header. As soon as the mobile is picked up the CMU changes to the signalling state *Call Established.*

Remote control `PROCedure:SIGNalling:ACTion MTC`

Send SMS

The *Send SMS* softkey activates the short message service.

It opens the *Short Message Service* popup menu: .



ROHDE & SCHWARZ Short Message Service Test.

The quick brown fox jumps over the lazy dog. 1234567890

Press CLR to clear the whole text.

Press ENTER to send the message

A text with a maximum of 160 alphanumeric characters can be entered in the input field. Two front panel keys control the short message service menu:

CLR	Clear the whole short message from the input field
ENTER	Send the short message in the input field to the mobile.

Remote control

```
PROCedure:SIGNalling:ACTion SMS
CONFigure:SIGNalling:SMS <Text>
SENSe:SIGNalling:SMS?
```

Open Pop. autom. ☐

The softkey *Open Pop. autom.* contains a field which activates or suppresses the display of the popup menu *Signalling (Signal On)*.

- In the default setting (*Open Pop. autom.* on), the popup menu is displayed each time the *Signal On* state is reached (due to a change of the signalling state or of the function group).
- In the alternative setting (*Open Pop. autom.* off), the popup-menu is suppressed. Signalling may still be controlled, e.g., via the mobile. Moreover, the popup menu *Signalling (Signal On)* can also be opened explicitly by pressing the corresponding hotkey in the menu group *Connection Control*.

Signalling Control in the Synchronized State

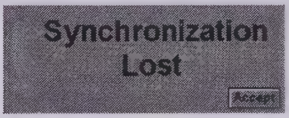
The popup menu *Signalling (Synchronized)* provides information on

- the current data of the mobile station *(Mobile Updated)*
- the status and result of the peak power measurement *(Power)*

Besides, it contains softkeys which lead to other signalling states:

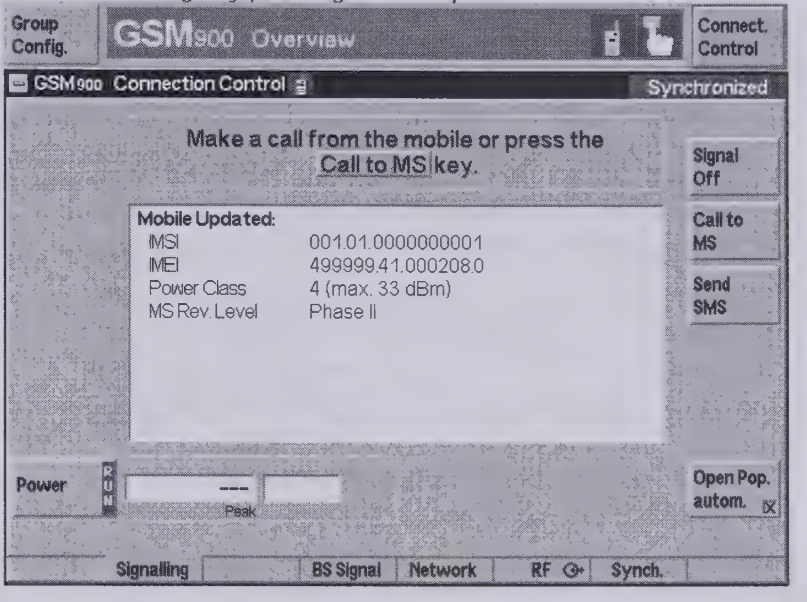
- Deactivation of the control channel signal for synchronization *(Signal Off)*
- Establishing a call to the mobile station (*Call to MS* state *Call Established)*
- Short message service *(Send SMS* return to state *Synchronized)*.

Note: *If the synchronization is lost during operation (because of a low signal level etc.) the warning Synchronization Lost ! will appear.*


Synchronization Lost

At the same time, bit 2 is set in the STATus:OPERation register. To continue, confirm the reception of the message by pressing the Accept button.

Connect. Control →



Make a call from the mobile or press the Call to MS key.

Mobile Updated:

IMSI	001.01.0000000001
IMEI	499999.41.000208.0
Power Class	4 (max. 33 dBm)
MS Rev. Level	Phase II

Fig. 4-31 Connection Control – Signalling (Synchronized)

The function of the *Power* softkey is described in the section *Signalling Control without Signal (State Signal Off)* on page 4.52, the softkeys *Signal Off* and *Send SMS* in the section *Signalling Control with Signal (State Signal On)* on page 4.54.

Header Message A Header Message (here: *Make a call from the mobile or press the "Call to MS" key)* displayed on top of each *Signalling* index card informs on the current instrument state or indicates how to proceed to get to other signalling states.

Mobile Updated The table *Mobile Updated* indicates mobile phone parameters transmitted to the CMU during the *location update*. In the *Synchronized* state, these are the international mobile subscriber identity *(IMSI*, a default value may be used for this parameter, see also section *Network Parameters* on page 4.96*)*, the international mobile station equipment identity *(IMEI)*, the power class as well as the GSM phase of the mobile station *(MS Rev. Level)*. A more detailed list of the signalling parameters appears after the call has been established (see section *Signalling Control with Call Established* on page 4.87).

Remote control `SENSe:MSSinfo:...?`

Call to MS

The softkey *Call to MS* establishes a call to the mobile station.

After this softkey is pressed the two successive header messages *Paging in progress ... Call to mobile in progress* are displayed. As soon as the mobile is picked up the CMU changes to the signalling state *Call Established.*

Remote control `PROCedure:SIGNalling:ACTion MTC`

Open Pop. autom. ☐	The softkey *Open Pop. autom.* contains a field which activates or suppresses the display of the popup menu *Signalling (Synchronized)*. • In the default setting (*Open Pop. autom.* on), the popup menu is displayed each time the *Synchronized* state is reached (due to a change of the signalling state or of the function group). • In the alternative setting (*Open Pop. autom.* off), the popup-menu is suppressed. Signalling may still be controlled, e.g., via the mobile. Moreover, the popup menu *Signalling (Synchronized)* can also be opened explicitly by pressing the corresponding hotkey in the menu group *Connection Control*.
Remote control	–

Overview of the Function Group

The main menu *Overview* provides an overview of the function group *GSM900/1800/1900-MS Signalling,* the current measurement status and the most important scalar parameters and measurement results. From here, the configuration menus *Group Configuration* and *Connection Control* as well as all measurement menus are directly accessible.

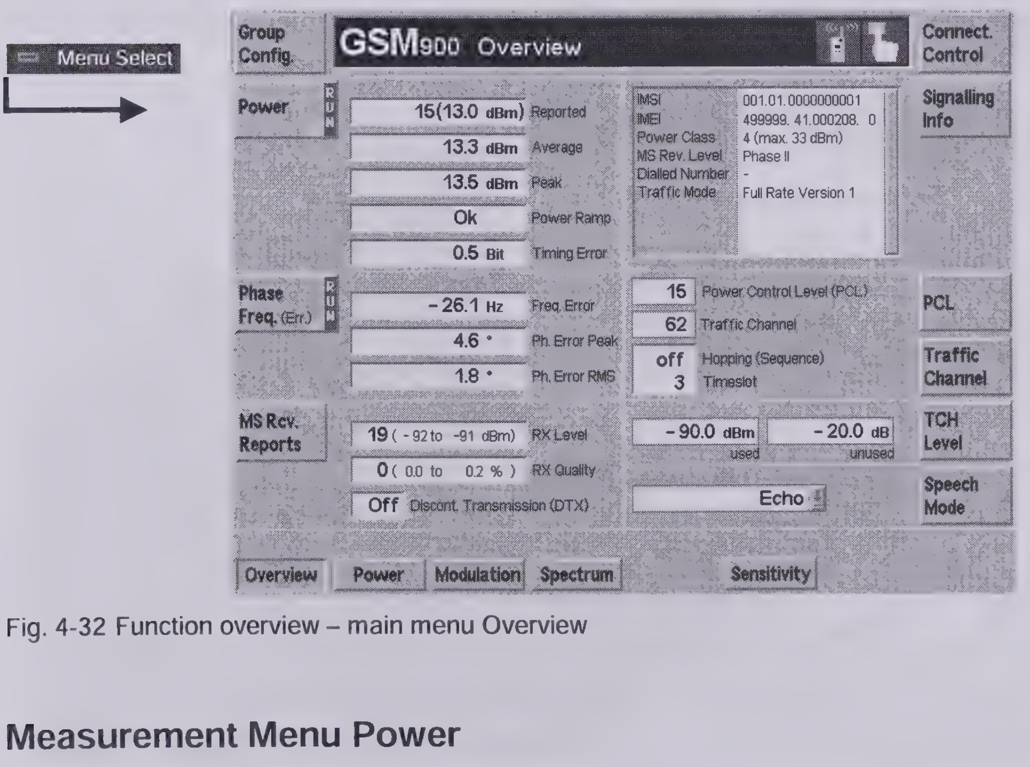
The main softkeys of the first four panels start the corresponding measurement and inform on its current status (*RUN / HLT / OFF).* The meaning of the measurement results output is discussed under the measurement menus:

Power	Burst power	*Power* menu, p. 4.59 ff.
Phase/Freq.	Modulation (phase and frequency error)	*Modulation* menu, p. 4.71 ff.
MS Rcv. Reports	Measurment reports from mobile station	*Sensitivity* menu, p. 4.77 ff.
Signalling Info	Parameters of the network and MS	See page 4.96 ff.

The remaining softkeys configure the PCL of the mobile and the BS (CMU) signals sent to the mobile station:

PCL/Traffic Channel	PCL of the mobile and BS signal parameters	See page 4.87
TCH Level/Speech Mode	Level in traffic channel and speech mode	See page 4.92

The main menu *Overview* is opened by selection of the function group in the main menu *Menu Select* (with associated key at the front of the instrument) and after closing the configuration menu *Connection Control - Signalling* (using the *Escape* key or automatically after establishing a call connection). It is linked with the measurement menus *Power, Modulation* and *Sensitivity* via the hotkeys.



15(13.0 dBm) Reported
13.3 dBm Average
13.5 dBm Peak
Ok Power Ramp
0.5 Bit Timing Error
- 26.1 Hz Freq. Error
4.6 ° Ph. Error Peak
1.8 ° Ph. Error RMS
19 (- 92 to -91 dBm) RX Level
0 (0.0 to 0.2 %) RX Quality
Off Discont. Transmission (DTX)

IMSI 001.01.0000000001
IMEI 499999. 41.000208. 0
Power Class 4 (max. 33 dBm)
MS Rev. Level Phase II
Dialled Number -
Traffic Mode Full Rate Version 1

15 Power Control Level (PCL)
62 Traffic Channel
off Hopping (Sequence)
3 Timeslot
- 90.0 dBm used
- 20.0 dB unused
Echo

Fig. 4-32 Function overview – main menu Overview

Measurement Menu Power

The menu group *Power* contains the functions for measurement of the received signal power as a function of time (burst analysis) and as a function of the power control level (PCL) of the mobile. The two measurements are treated as two different applications; the results are displayed in two separate measurement menus *Power (P/t* and *P/PCL).* The popup menu *Power Configuration* is used for configuration of both measurements.

The P/PCL measurement represents a fast method of measuring the average burst power transmitted on all PCLs supported by a mobile. The measurement relies on the fact that a GSM mobile, when changing from one PCL to another, steps through the whole range of intermediate PCLs, dwelling on each level for a period corresponding to 13 TDMA frames (577µs x 8 x 13 ≈ 60 ms). The CMU measures the average burst power in the whole PCL range, starting with the highest output power level (i.e. the smallest PCL, see Table 4-7 on page 4.68).

The P/PCL measurement is combined with frequency hopping on three uplink GSM channels. In addition, a limit check with PCL-dependent tolerances is performed. The results are output in tabular form.

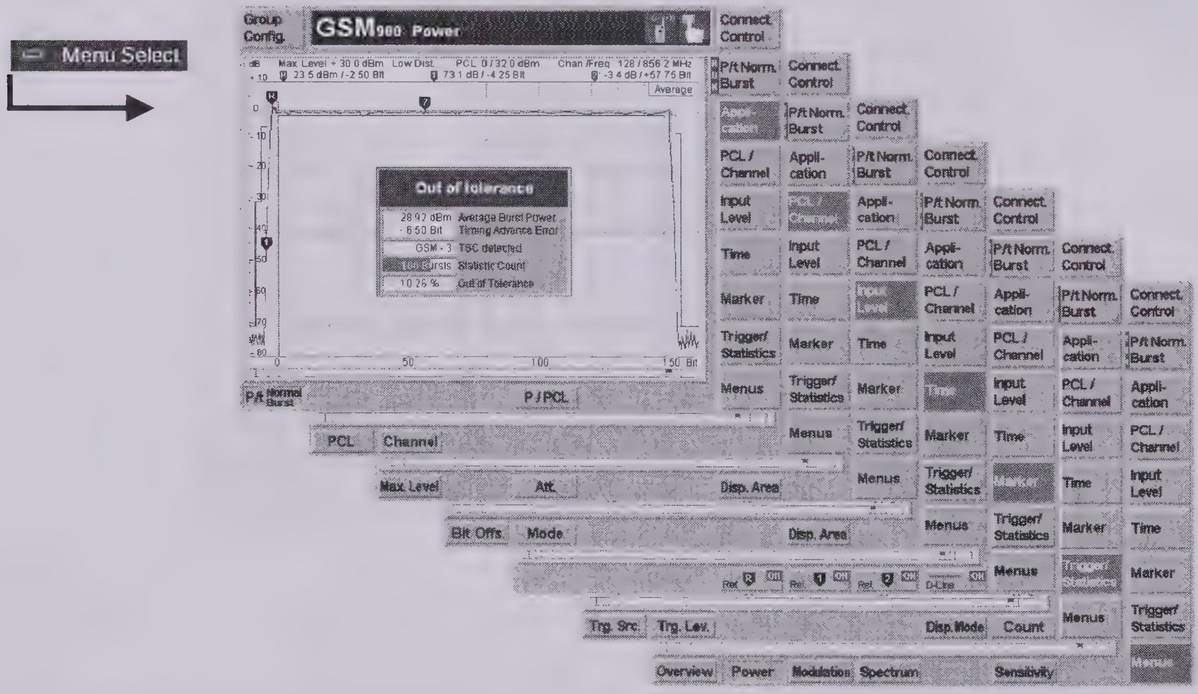
Most settings and functions of the *P/t Normal Burst* application do not depend on the signalling state and correspond to those of the menu *Power vs Time* in the operating mode *GSM900/1800/1900-MS Non Signalling*. For a detailed description of these functions refer to p. 4.5 ff.

Measurement Menu (*Power*)

The graphical measurement menu *Power* displays the results of the power measurement.

- The main softkey *P/t Normal Burst* (which changes to *P/PCL* if that application is selected) indicates the status of the power measurement *(RUN | HLT | OFF)* and opens the configuration menu *Power Configuration*.
- The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the hotkeys *Bit Offs., Mode,* and *Disp. Area* belong to the softkey *Time)*. If a softkey is selected and an associated hotkey pressed, a popup window will appear which indicates the current setting and enables an entry.

The measurement menu *Power* is opened from the main menu *Menu Select* (with the associated key at the front of the instrument) or using the hotkey *Power*.


Menu Select
Group Config.
GSM900 Power
Connect Control
Max Level + 30.0 dBm Low Dist. PCL 0 / 32.0 dBm Chan /Freq 128 / 856.2 MHz
23.5 dBm / -2.50 Bit 73.1 dB / -4.25 Bit -3.4 dB / +57.75 Bit
Average
0 50 100 150 Bit
P/t Normal Burst
P / PCL
Application
PCL / Channel
Input Level
Time
Marker
Trigger/ Statistics
Menus
PCL Channel
Max. Level Att. Disp. Area
Bit Offs. Mode Disp. Area
Ref. On D-Line
Trg. Src. Trg. Lev. Disp. Mode Count
Overview Power Modulation Spectrum Sensitivity

Out of tolerance
28.92 dBm Average Burst Power
- 6.50 Bit Timing Advance Error
GSM - 3 TSC detected
100 Bursts Statistic Count
10.26 % Out of Tolerance

Fig. 4-33 Measurement menu Power – P/t Normal Burst

Test Settings

Application	The *Application* softkey activates the selection of the power measurement type.
P/t Normal Burst	The *P/t Normal Burst* hotkey selects the power versus time measurement of the normal burst.
Remote control	The *P/T Normal Burst* application is selected by the optional keyword `[:NORMal]` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer[:NORMal]...`
P/PCL	The *P/PCL* hotkey selects the power versus PCL measurement.
Remote control	The *P/PCL* application is selected by the keyword `:PCL` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:PCL...`

The following test settings depend on the application selected.

a) P/t Normal Burst

PCL Channel	The *PCL Channel* softkey determines the mobile power and the traffic channel.
PCL	The *PCL* hotkey sets the mobile power. The mobile power is defined in power control levels without dimension (see section *Limit Values for Average Burst Power* on page 4.68. They are indicated in the *Overview* menu (see p. 4.59).
Remote control	`PRROCedure:SIGNalling:MS:PCL 0 ... 31`
Channel	The *Access* hotkey sets the number of the traffic channel. The channel number is also indicated in the *Overview* menu (see p. 4.59). For an overview of GSM channel structure see tables in section *Control of Input and Ouput Signals* on page 4.37.
Remote control	`PROCedure:SIGNalling[:TCH]:CHANnel <number>`
Input Level	The *Input Level* softkey sets the input level.
Max. Level	The *Max. Level* hotkey defines the maximum input level. See also the section *Input Level (Group Configuration – Input Level)* on p. 4.102.
Remote control	`[SENSe:]LEVel:MAXimum <Level>`

Mode

The *Mode* hotkey defines how the reference level is determined.

- *PCL* Automatic setting according to the selected PCL. The power control level is set in the *Overview* menu or using the softkey *PCL Channel* (see above).
- *Manual* Manual input of reference level

See also section *Input Level (Group Configuration – Input Level)* on p. 4.102.

Remote control `[SENSe:]LEVel:MODE MANual | PCLevel`

Atten.

The *Atten.* hotkey defines an attenuation factor for the input signal.

- *Normal* Input signal is maintained unchanged,
- *Low Noise* Full dynamic range,
- *Low Distortion* high overdrive reserve.

See also section *Input level (Group Configuration – Input Level)* on p. 4.102.

Remote control `[SENSe:]LEVel:ATTenuation NORMal | LNOise | LDIStortion`

Disp. Area

The *Disp. Area* hotkey determines the display area.

Either the complete burst or particular parts of it can be selected, see section *GSM900/1800/1900-MS Non Signalling* (p. 4.6 ff.).

Remote control No command, pure screen configuration.

Time

The *Time* softkey configures the abscissa (time axis). All settings are identical with those in section *GSM900/1800/1900-MS Non Signalling* (p. 4.6 ff.).

Marker

The *Marker* softkey positions up to 3 markers and a D-line in the test diagram and outputs their values, see section *GSM900/1800/1900-MS Non Signalling* (p. 4.6 ff.).

Trigger Statistics

The *Trigger/Statistics* softkey sets the trigger condition, the statistics mode and the number of statistic counts, see section *Trigger* on page 4.103 ff.

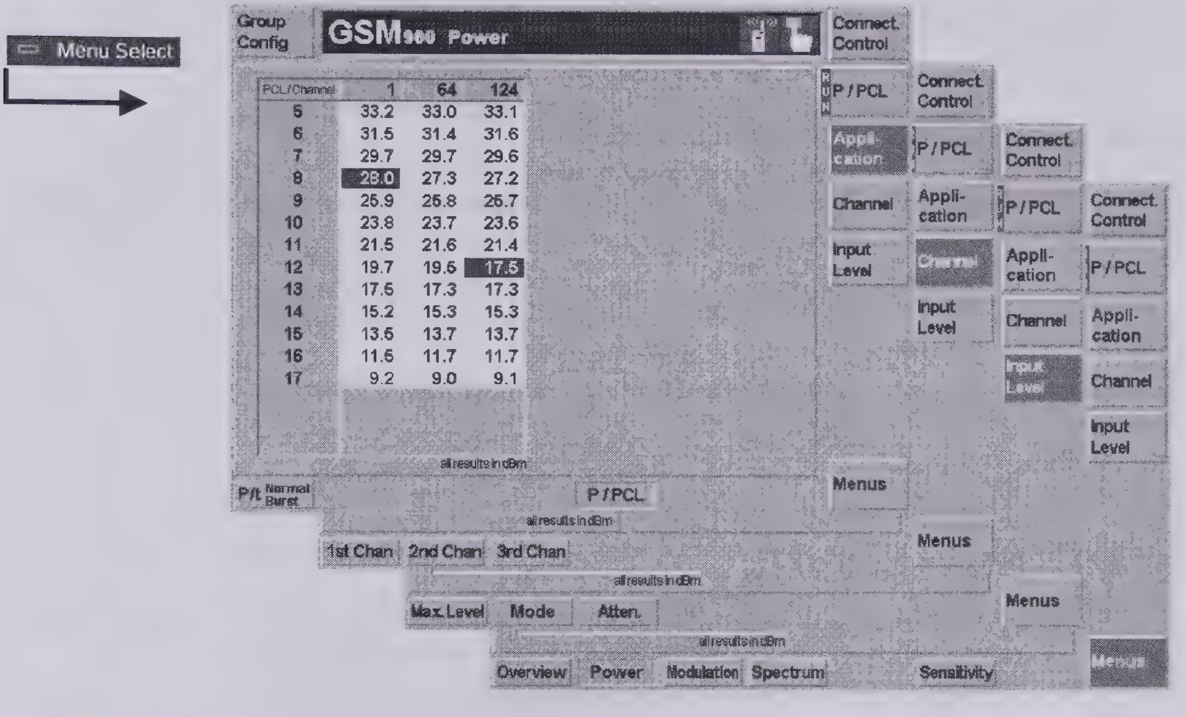
Difference from *Non Signalling* mode (p. 4.6 ff.):

In the mode *GSM900/1800/1900-MS Signalling*, the measurement is triggered by the signal from the signalling unit or the mobile phone. Triggering by an additional external signal is not possible.

Menus

The softkey *Menus* displays the hotkey bar for switching over to the other measurement menus.

b) P/PCL


Menu Select
Group Config
GSM900 Power
Connect. Control
P / PCL
Appli-cation
Channel
Input Level
Menus
P/t Normal Burst
1st Chan
2nd Chan
3rd Chan
Max. Level
Mode
Atten.
Overview
Power
Modulation
Spectrum
Sensitivity

PCL/Channel	1	64	124
5	33.2	33.0	33.1
6	31.5	31.4	31.6
7	29.7	29.7	29.6
8	28.0	27.3	27.2
9	25.9	25.8	25.7
10	23.8	23.7	23.6
11	21.5	21.6	21.4
12	19.7	19.6	17.5
13	17.5	17.3	17.3
14	15.2	15.3	15.3
15	13.6	13.7	13.7
16	11.5	11.7	11.7
17	9.2	9.0	9.1

all results in dBm

Fig. 4-34 Measurement menu Power – P/PCL

The settings of the *Application, Input Level,* and *Menus* softkey are identical with those of application *P/t Normal Burst,* see above. In application P/PCL, a new softkey for channel selection is provided.

Channel The *Channel* softkey defines three channels for the P/PCL measurement.

1st Chan The *1st Chan* hotkey defines the first GSM channel to be measured.

For a list of GSM channels refer to the tables in section *Control of Input and Output Signals* (p. 4.37 ff; the analyzed channels are uplink channels).

Remote control `CONFigure:POWer:PCL:CHANnel <Channel1>,<Channel2>,<Channel3>`

The two remaining hotkeys select the second and third channel, respectively.

Measurement Results

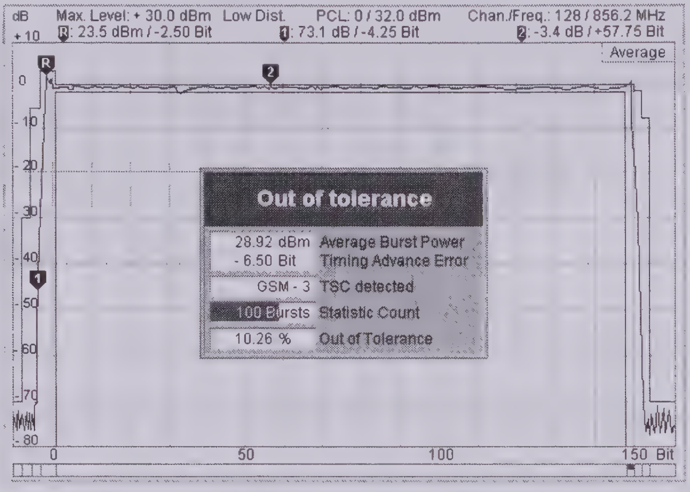
The measurement results depend on the application selected.

a) P/t Normal Burst

The results displayed in the measurement menu *Power*, application *P/t Normal Burst*, can be divided into three groups:

- Settings
- Scalar measurement results (single values),
- Arrays (the trace plotted as a function of time).

The measurement results are indicated in two parameter lines, the test diagram and an info box:



Parameter line 1 / 2

Test diagram

Info box

dB Max. Level: + 30.0 dBm Low Dist. PCL: 0 / 32.0 dBm Chan./Freq.: 128 / 856.2 MHz

+10 R: 23.5 dBm / -2.50 Bit 1: 73.1 dB / -4.25 Bit 2: -3.4 dB / +57.75 Bit

Average

Out of tolerance

28.92 dBm	Average Burst Power
- 6.50 Bit	Timing Advance Error
GSM - 3	TSC detected
100 Bursts	Statistic Count
10.26 %	Out of Tolerance

Fig. 4-35 Display of measurement results (P/t Normal Burst menu)

Settings/ scalar results Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the info box, a popup window in the middle of the graphical screen *Power*.

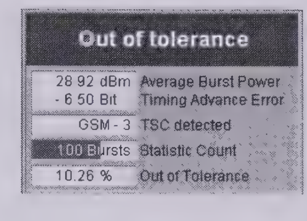
1st parameter line The first parameter line contains the following settings:

Max. Level	Maximum input level set as in *Input Level – Max. Level* (p. 4.102)
Attenuation	Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)*
PCL	Power control level and corresponding output power of mobile
Chan./Freq	RF channel and associated frequency

2nd parameter line The second parameter line contains the following marker values:

R	Level and time of reference marker
1	Level and time of delta marker 1 (setting *absolute*) and/or difference from reference marker (setting *relative*)
2	Level and time of delta marker 2 (setting *absolute*) and/or difference from reference marker (setting *relative*)

Info box



Out of tolerance

28 92 dBm	Average Burst Power
- 6 50 Bit	Timing Advance Error
GSM - 3	TSC detected
100 Bursts	Statistic Count
10.26 %	Out of Tolerance

The info box contains the following settings:

Display Mode	Displayed trace: *Minimum, Maximum, Average, Current*
Statistic Count	Number of bursts per measurement cycle

In addition, it indicates the results for the scalar measured values:

Avg. Burst Power	Average power of current burst, irrespective of the current display of measurement results
Timing Adv.	Error due to timing advance in bits. This measured value *Error* replaces the setting value *Bit Shift* in the measurement without signalling
Out of Limit	Relative share of measured bursts that are out of the tolerances defined by the limit lines
Burst Matching	Error message if the displayed burst is out of tolerance. The message depends on the selected display mode

Remote control

Settings are read out using the query corresponding to the setting command (setting command with appended question mark).

For scalar measurement results:

```
READ[:SCALar]:POWer[:NORMal][:RESult]
CALCulate:POWer[:NORMal][:RESult]:LIMit:MATChing?
FETCh[:SCALar]:POWer[:NORMal][:RESult]?
SAMPle[:SCALar]:POWer[:NORMal][:RESult]?
```

Traces (arrays)

The measurement result is displayed in graphical as a continuous trace in the test diagram together with the limit lines, markers, and the D-line, if defined.

The trace in the *Power* measurement menu shows the measured burst power (in dB) as a function of time (in bits). The displayed result depends on the test settings. The display mode for the trace *(Minimum, Maximum, Average, Current)* is indicated in the upper right corner of the diagram.

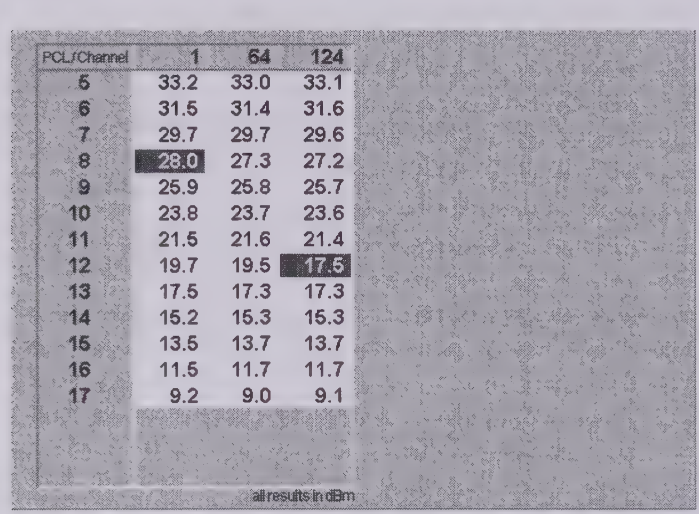
The scale of both axes can be changed via the *Disp. Area* hotkey (see above).

Remote control

```
READ:ARRay:POWer[:NORMal][:RESult]:BURSt...
READ:ARRay:POWer[:NORMal][:RESult]:BURSt:LIMit:MATChing:...
FETCh:ARRay:POWer[:NORMal][:RESult]:BURSt...?
SAMPle:ARRay:POWer[:NORMal][:RESult]:BURSt...?
```

b) P/PCL

The measurement menu *Power*, application *P/PCL*, contains a table of all measured average burst powers.



PCL/Channel	1	64	124
5	33.2	33.0	33.1
6	31.5	31.4	31.6
7	29.7	29.7	29.6
8	28.0	27.3	27.2
9	25.9	25.8	25.7
10	23.8	23.7	23.6
11	21.5	21.6	21.4
12	19.7	19.5	17.5
13	17.5	17.3	17.3
14	15.2	15.3	15.3
15	13.5	13.7	13.7
16	11.5	11.7	11.7
17	9.2	9.0	9.1

all results in dBm

Fig. 4-36 Display of measurement results (P/PCL menu)

PCL/Channel

The *PCL/Channel* table contains the average burst power for all PCLs supported by the mobile, starting with the maximum output power (lowest PCL) and in the three channels selected via the *Channel* softkey. If the tolerance value defined in the *Limits* card of the *Power Configuration* menu (see p. 4.68 ff) is violated, the result is shown on a red background.

If more than 16 different PCLs are supported, the table consists of two columns.

Remote control

```
READ[:SCALar]:POWer:PCL[:RESult]
CALCulate:POWer:PCL[:RESult]:LIMit:MATChing?
FETCh[:SCALar]:POWer:PCL[:RESult]?
SAMPle[:SCALar]:POWer:PCL[:RESult]?
```

Measurement Configurations (Power Configuration)

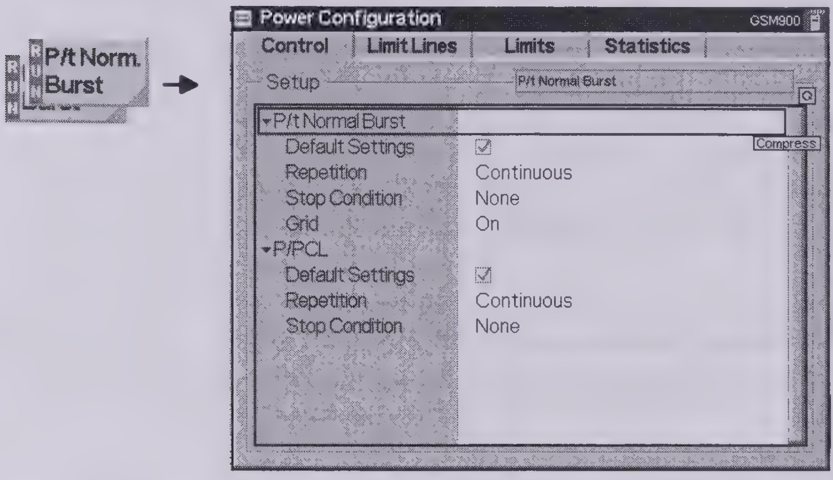
The popup menu *Power Configuration* contains four index cards which determine the parameters of power measurement and provide graphical tools for evaluation of the measurement results.

The popup menu *Power Configuration* is activated by pressing the softkey *Power* at the top right in the graphical measurement menu *Power* twice. It is possible to change between the index cards by pressing the associated hotkeys.

Measurement Control (Power Configuration – Control)

The index card *Control* controls the power measurement by determining

- The *Repetition* mode
- The *Stop Condition* for the measurement
  - Besides, it influences the power display by fading in and out a *Grid*.



Setup: P/t Normal Burst

▾P/t Normal Burst
  Default Settings ☑
  Repetition Continuous
  Stop Condition None
  Grid On
▾P/PCL
  Default Settings ☑
  Repetition Continuous
  Stop Condition None

Fig. 2-37 Power Configuration – Control

All settings can be defined separately for the two applications *P/t Normal Burst* and *P/PCL*. They are described in the section *GSM900/1800/1900-MS Non Signalling* on page 4.12 ff.

Limit Lines (Power Configuration – Limit Lines)

The index card *Limit Lines* defines the limit lines for the burst analysis (application *P/t Normal Burst*). Limit lines are a graphical tool for defining and monitoring tolerance values. The index card enables

- An overview of the default limit lines and areas *(Area Info)*
- Definition of the limit lines for the normal bursts section by section *(Upper Limit Line/Lower Limit Line*

The functions of this menu are described in the section *GSM900/1800/1900-MS Non Signalling* on page 4.14 ff. The *dynamic limit line correction*, however, serves to correct the limit lines depending on the PCL of the mobile phone and is available in the Signalling mode only:

Dynamic limit line correction

The *dynamic* correction to the limit lines is defined as follows:

Range 1 to 10	Continuous range of power control levels defined by start PCL and stop PCL
PCL from	Lowest power control level in the range
PCL to	Highest power control level in the range
Correction	Correction value in dB to be applied to the whole range
Enable	Enabled (switch on) or disabled dynamic correction

Remote control

```
CONFigure:POWer:LIMit:LINE<nr>:DYNamic[:ENABle] ON | OFF
CONFigure:POWer:LIMit:LINE:ALL:DYNamic[:ENABle] ON | OFF
CONFigure:POWer:LIMit:LINE:<AreaNo>:DYNamic<RangeNo>
        <fromPCL>,<toPCL>,<Correction>,<Enable> etc.
```

Limit Values for Average Burst Power (Power Configuration – Limits)

The index card *Limits* defines tolerance limits for the average burst power depending on the power control level of the mobile phone *(PCL)*. The limits apply to both applications of the *Power* menu.

GSM mobile phones are divided into different power classes according to their maximum output power:

Table 4-6 GSM Power classes

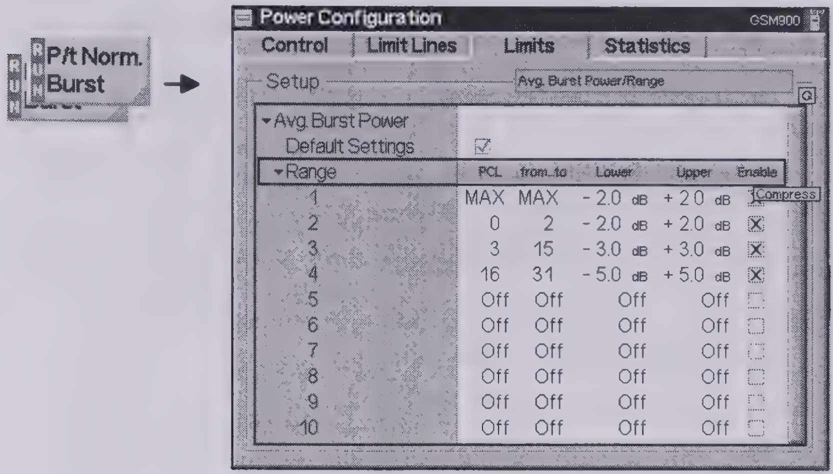
Power class	Nominal maximum output power in dBm		
	GSM900	GSM1800	GSM1900
1	–	30	30
2	39	24	24
3	37	36	33
4	33		
5	29		

Besides, a dimensionless scale of power control levels *(PCL)* is determined for dynamic control of the mobile power:

Table 4-7 GSM Power control levels (PCL)

Power control level, PCL	Nominal output power in dBm		
	GSM900	GSM1800	GSM1900
0	39	30	30
1	39	28	28
2	39	26	26
3	37	24	24
4	35	22	22
5	33	20	20
6	31	18	18
7	29	16	16
8	27	14	14
9	25	12	12
10	23	10	10
11	21	8	8
12	19	6	6
13	17	4	4
14	15	2	2
15	13	0	0
16	11	0	0
17	9	0	0
18	7	0	0
19 - 28	5	0	0
29	5	36	36
30	5	34	33
31	5	32	32
	PCL 16 to 31 for phase 2 only	PCL 11 to 15, 29 to 31 for phase 2 only	PCL 11 to 15, 29 to 31 for phase 2 only

Besides, tolerance values are specified for all output powers under various conditions. Power control permits to force the mobile power below the maximum value corresponding to its power class.



Avg. Burst Power

Default Settings ☑

Range	PCL	from..to	Lower	Upper	Enable
1	MAX	MAX	-2.0 dB	+2.0 dB	☒
2	0	2	-2.0 dB	+2.0 dB	☒
3	3	15	-3.0 dB	+3.0 dB	☒
4	16	31	-5.0 dB	+5.0 dB	☒
5	Off	Off	Off	Off	☐
6	Off	Off	Off	Off	☐
7	Off	Off	Off	Off	☐
8	Off	Off	Off	Off	☐
9	Off	Off	Off	Off	☐
10	Off	Off	Off	Off	☐

Fig. 4-38 Power Configuration – Limits

Average Burst Power

The table *Average Burst Power* defines a tolerance band for the average burst power. Matching of the tolerances is checked for each burst measured.

The limit values are defined relative to the nominal output power corresponding to the mobile's power control level (see Table 4-7). An upper and lower limit can be defined for up to 10 arbitrary, continuous ranges of PCLs. In contrast to the modulation measurement, these power limits may also be asymmetrical (i.e. not of the same magnitude). The table contains the following columns:

Range	Current range number
PCL:from	Initial PCL in the range 0 to 31, MAX
... to	Final PCL in the range (greater or equal to the initial PCL)
Lower	Lower level limit relative to nominal output power
Upper	Upper level limit relative to nominal output power
Enable	Enable (box checked) or disable the limit check in the current range

If the initial PCL coincides with the final PCL, the range consists of one power control level only. Unused ranges are marked by the entries *Off*. The entry *MAX* refers to the maximum PCL of the mobile phone according to its power class.

Remote control

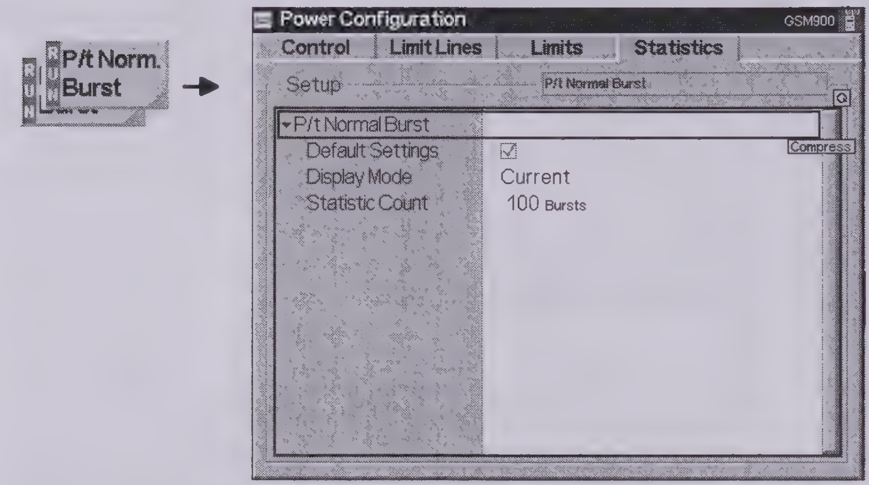
```
CONFigure:Power:LIMit:ABPower<nr>[:ENABle] ON | OFF
CONFigure:Power:LIMit:ABPower<nr>
         <StartPCL>,<StopPCL>,<LowerLimit>,<UpperLimit>
```

Default Settings

The *Default* overwrites all settings of the *Limits* index card with default values.

Statistic Counts (Power Configuration – Statistics)

- The index card *Statistics* defines the number of bursts constituting a statistic count and the display mode (i.e. the power ramp displayed).


P/t Norm. Burst
RUN
Power Configuration
GSM900
Control
Limit Lines
Limits
Statistics
Setup
P/t Normal Burst
Compress

P/t Normal Burst

Default Settings ☑

Display Mode Current

Statistic Count 100 Bursts

Fig. 2-39 Power Configuration – Statistics

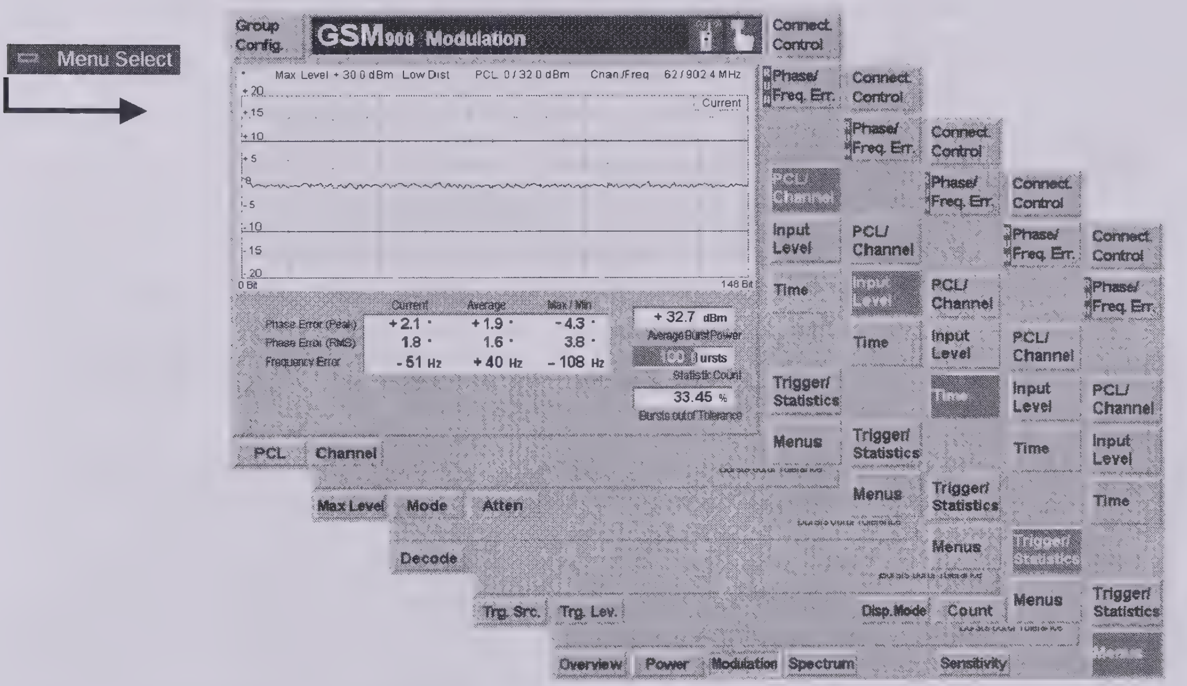
All settings can be defined separately for the two applications *P/t Normal Burst* and *P/PCL*. They are described in the section *GSM900/1800/1900-MS Non Signalling* on page 4.16 ff. For explanation of the settings see also chapter 3.

Measurement Menu Modulation

The menu group *Modulation* contains the functions for measurement of the modulation parameters, i.e. the frequency and phase error in the burst and matching of the respective tolerance limits. The popup menu *Modulation Configuration* is used for configuration of the measurements; the measurement results are displayed in the graphical measurement menu *Modulation*.

Apart from few exceptions, the menu group *Modulation* does not differ from its corresponding menu group in the measurement mode *GSM900/1800/1900-MS Non Signalling* (see p. 4.18 ff.):

1. In addition to the maximum input level, the attenuation and the RF channel, the first parameter line also contains the power control level (PCL) of the mobile. The PCL can be set via the *PCL/Channel* softkey and can be used to define the input level *(Input Level* softkey).
2. The trigger sources *Signalling, Free Run, RF Power,* and *IF Power* are available. This means that the measurement is triggered by the signal from the CMU's signalling unit or the mobile phone; triggering by an additional external signal (parameter *External)* is not possible.


Menu Select
Group Config.
GSM900 Modulation
Connect. Control
Max Level + 30.0 dBm Low Dist PCL 0 / 32.0 dBm Chan./Freq 62 / 902.4 MHz
+20
+15
+10
+5
0
-5
-10
-15
-20
Current
0 Bit
148 Bit
Phase/ Freq. Err.
PCL/ Channel
Input Level
Time
Trigger/ Statistics
Menus
PCL
Channel
Max Level
Mode
Atten
Decode
Trg. Src.
Trg. Lev.
Disp.Mode
Count
Overview
Power
Modulation
Spectrum
Sensitivity

	Current	Average	Max / Min
Phase Error (Peak)	+ 2.1 °	+ 1.9 °	- 4.3 °
Phase Error (RMS)	1.8 °	1.6 °	3.8 °
Frequency Error	- 51 Hz	+ 40 Hz	- 108 Hz

+ 32.7 dBm Average Burst Power

100 Bursts Statistic Count

33.45 % Bursts out of Tolerance

Fig. 4-40 Measurement menu Modulation

Test Settings

PCL Channel

The *PCL Channel* softkey defines the mobile power and the traffic channel.

PCL

The *PCL* hotkey sets the mobile power.

The mobile power is defined in power control levels without dimension (see section *Limit Values for Average Burst Power (Power Configuration – Limits)* on page 4.68. They are indicated in the *Overview* menu.

Remote control `PRROCedure:SIGNalling:MS:PCL 0 ... 31`

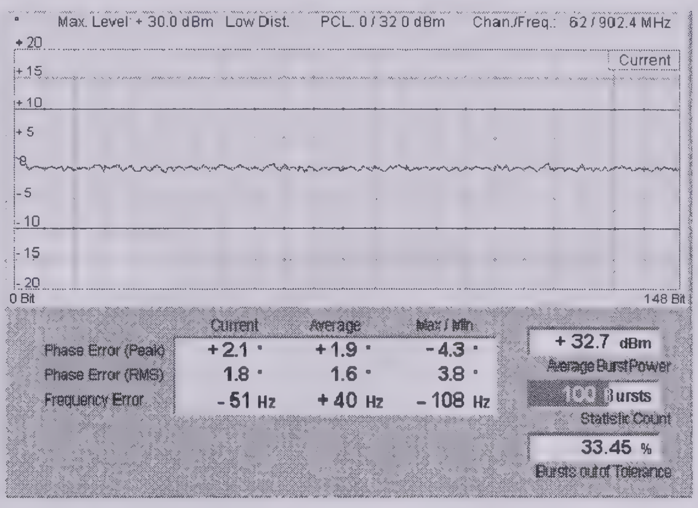
Channel	The *Channel* hotkey sets the number of the traffic channel. The channel number is also indicated in the *Overview* menu.
Remote control	`PRROCedure:SIGNalling[:TCH]:CHANnel <number>`
Input Level	The *Input Level* softkey sets the input level. See also the section *Input Level (Group Configuration – Input Level).*
Mode	The *Mode* hotkey defines how the reference level is determined. *PCL* Automatic setting according to the selected PCL. The power control level is set in the *Overview* menu or using the softkey *PCL Channel* (see above). *Manual* Manual input of reference level See also section *Input Level (Group Configuration – Input Level).*
Remote control	`[SENSe:]LEVel:MODE MANual | PCLevel`
Atten.	The *Atten.* hotkey defines an attenuation factor for the input signal. *Normal* Input signal is maintained unchanged, *Low Noise* Full dynamic range, *Low Distortion* high overdrive reserve. See also section *Input level (Group Configuration – Input Level).*
Remote control	`[SENSe:]LEVel:ATTenuation NORMal | LNOIse | LDIStortion`
Time	The *Time* softkey configures the abscissa (time axis). All settings are identical with those in section *GSM900/1800/1900-MS Non Signalling* (see p. 4.19 ff.).
Marker	The *Marker* softkey positions up to 3 markers and a D-line in the test diagram and outputs their values, see p. 4.19 ff.
Trigger Statistics	The *Trigger/Statistics* softkey sets the trigger condition, the statistics mode and the number of statistic counts, see section *GSM900/1800/1900-MS Non Signalling.* **Difference from *Non Signalling* mode (see p. 4.19 ff.):** In the mode *GSM900/1800/1900-MS Signalling*, the measurement is triggered by the signal from the signalling unit or the mobile phone. Triggering by an additional external signal is not available.
Menus	The softkey *Menus* displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The values shown in the measurement menu *Modulation* can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (the trace plotted as a function of time)

The values are indicated in two parameter lines, the test diagram and a tabular overview below:



Parameter line 1 | 2

Test diagram

Output table

Max. Level + 30.0 dBm Low Dist. PCL 0 / 32.0 dBm Chan./Freq.: 62 / 902.4 MHz

	Current	Average	Max / Min
Phase Error (Peak)	+ 2.1 °	+ 1.9 °	- 4.3 °
Phase Error (RMS)	1.8 °	1.6 °	3.8 °
Frequency Error	- 51 Hz	+ 40 Hz	- 108 Hz

+ 32.7 dBm Average Burst Power

100 Bursts Statistic Count

33.45 % Bursts out of Tolerance

Fig. 4-41 Display of results (modulation menu)

In contrast to the *Non Signalling* mode (see p. 4.21 ff.) the first parameter line contains also the PCL of the mobile station. Besides the representation and interpretation of the results are identical.

Measurement Configurations (Modulation Configuration)

The popup menu *Modulation Configuration* contains three index cards which define the parameters of the phase and frequency error measurement including the error tolerances.

The popup menu *Modulation Configuration* is activated by pressing the softkey *Phase/Freq.* in the top right of the graphical measurement menu *Modulation* twice. By pressing the associated hotkeys, it is possible to change between the index cards.

The functions of the *Modulation Configuration* menus are described in section *GSM900/1800/1900-MS Non Signalling*, see p. 4.22 ff.

Measurement Menu Spectrum

The menu group *Spectrum* contains the functions for measurement of the off-carrier power, which is due to the modulation and the bursty nature of the RF signal. The popup menu *Spectrum Configuration* is used for configuration of the measurements; the measurement results are displayed in the graphical measurement menus *Spectrum.*

Apart from few exceptions, the menu group *Spectrum* does not differ from its corresponding menu group in the measurement mode *GSM900/1800/1900-MS Non Signalling* (see p. 4.18 ff.):

1. In addition to the maximum input level, the attenuation, and the RF channel, the first parameter line also indicates the timeslot number of the base station signal. The PCL can be set via the *PCL/Channel* softkey and can be used to define the input level *(Input Level* softkey).
2. The trigger sources *Signalling, Free Run, RF Power,* and *IF Power* are available. This means that the measurement is triggered by the signal from the CMU's signalling unit or the mobile phone; triggering by an additional external signal (parameter *External*) is not possible.

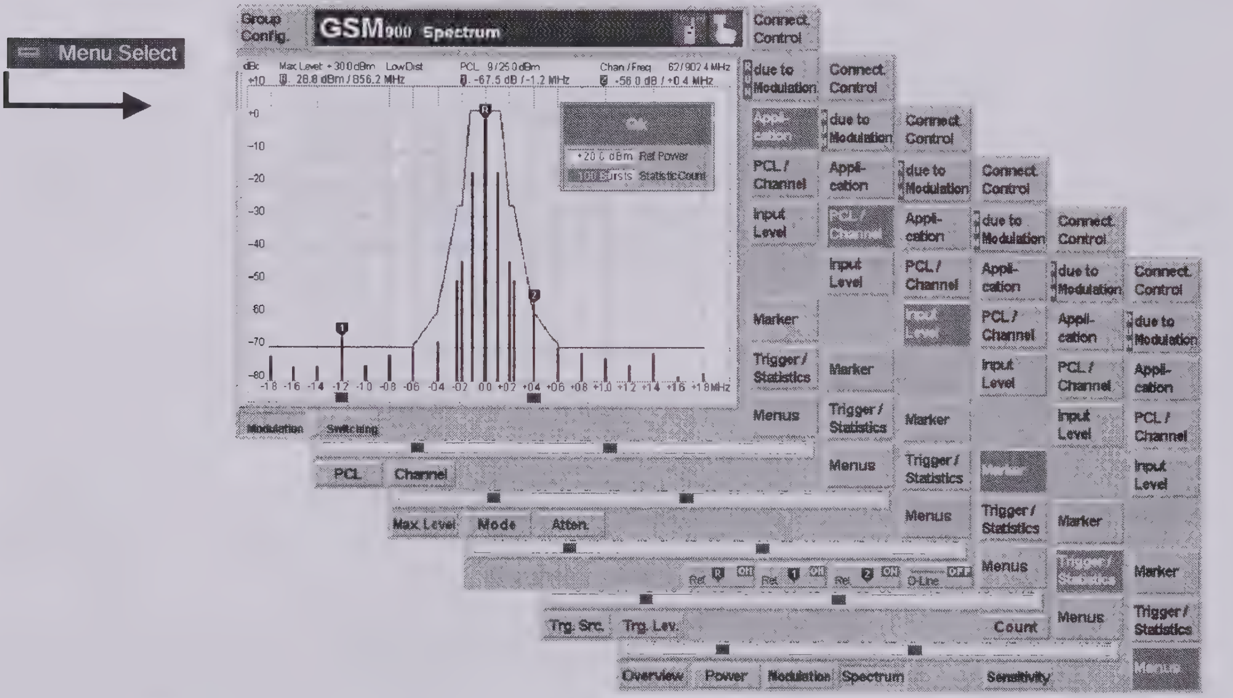

Menu Select
Group Config.
GSM900 Spectrum
Connect. Control
due to Modulation
Appli-cation
PCL / Channel
Input Level
Marker
Trigger / Statistics
Menus
Max.Level: +30.0 dBm LowDist
PCL 9 / 25.0 dBm
Chan / Freq 62 / 902.4 MHz
28.8 dBm / 856.2 MHz
-67.5 dB / -1.2 MHz
-56.0 dB / +0.4 MHz
+20.0 dBm Ref Power
100 Bursts Statistic Count
Modulation
Switching
PCL
Channel
Max.Level
Mode
Atten.
Ref.
D-Line
Trg. Src.
Trg. Lev.
Count
Overview
Power
Modulation
Spectrum
Sensitivity

Fig. 4-42 Measurement menu Spectrum (application due to Modulation)

Test Settings

The selections and test settings provided by the *Application, Input Level,* and *Menus* softkeys are identical with those in the *Non Signalling* mode (see section *Test Settings* on page 4.19). The *PCL / Channel* and *Trigger/Statistics* softkeys are equal to the softkeys of the same name in the *Power* menu (see page 4.61 ff).

Measurement Results

The *Spectrum* measurement menu and the results depend on the type of spectrum (application *due to Modulation* or *due to Switching*) selected.

In contrast to the *Non Signalling* mode (see p. 4.21 ff.) the first parameter line also contains the PCL of the mobile. Besides, the interpretation of the results is identical.

Measurement Configurations (Spectrum Configuration)

The popup menu *Spectrum Configuration* contains three index cards which define the parameters of the spectrum measurement including the error tolerances.

The popup menu *Spectrum Configuration* is activated by pressing the main softkey in the top right of the graphical measurement menu *Spectrum* twice (this softkey reads *due to Modulation* or *due to Switching*, depending on the selected application). By pressing the associated hotkeys, it is possible to change between the index cards.

The functions of the *Spectrum Configuration* menu are described in section *GSM900/1800/1900-MS Non Signalling*, see p. 4.22 ff.

Sensitivity Measurements

The menu group *Sensitivity* measures parameters which characterize the quality of transmission on the complete transmission path from the CMU to the device under test (mobile station) and back. In particular, assuming that transmitter errors do not occur, this allows to assess the sensitivity of the mobile station receiver at low RF power levels.

The popup menu *SENSITIVITY Configuration* is used for configuration of the measurements; the measurement results are directly indicated in the main menu *Sensitivity*.

The measurements in the menu group *Sensitivity* assume that a call has been set up (signalling state *Call Established)*. This is why they are not available in the mode *GSM900/1800/1900-MS Non Signalling*.

Principle of the measurement

The sensitivity measurement is based on the comparison of the output signal sent by the CMU with the signal received and decoded by the device under test (mobile station).
To this end, the mobile station must return the received signal to the CMU in loop back mode. In most cases, a test SIM card is required for this purpose.

Because of the higher signal level, the transmission errors produced on the way back (from the mobile station to the CMU) can usually be neglected. However, frames destroyed on the way back are detected in a cyclic redundancy check (CRC) and counted. They are not taken into account in the calculation of transmission errors.

The quality of the mobile station transmitter can be tested separately in the *Modulation* measurement.

Bit classes

In the GSM system, the speech coder combines the speech information into data blocks with a length of 260 bits, the so-called frames. Within one frame, the bits are divided into bit classes:

- The 78 *class II bits* have no error protection which is why they quickly produce transmission errors.
- The 132 *class Ib bits* are partly protected against errors during channel coding (by added guard bits).

The 50 most important *class Ia bits* are well protected. The mobile phone itself recognizes erroneous *class Ia bits* and clears the complete frame if no correction is possible

Definition of measured quantities

The Bit Error Rate *(BER)* is the ratio of erroneous bits to the total number of transferred bits in percent (also referred to as samples in the operating mode *BER*). The CMU outputs the bit error rate according to bit classes:

BER = erroneous bits / total number of bits * 100%
BER II = erroneous class II bits / total number of class II bits * 100%
BER Ib = erroneous class Ib bits / total number of class Ib bits * 100%

The Frame Erasure Rate *(FER)* is the ratio of frames recognized to be erroneous and erased by the mobile to the total number of transferred frames in percent:

FER = Erroneous frames / total number of frames * 100%

The Residual Bit Error Rate *(RBER)* characterizes the quality of transmission of the valid frames (not erased, therefore residual). It corresponds to the ratio of the erroneous bits to the total number of transferred bits in percent, the numerator and denominator referring only to the **valid frame** *(residual frames, RF)*:

RBER II = erroneous class II bits (RF) / total number of class II bits (RF) * 100%
RBER Ib = erroneous class Ib bits (RF) / total number of class Ib bits (RF) * 100%

Burst by Burst mode (fast BER)

In the *Burst by Burst* mode, the CMU transmits only bits without error protection (class II bits); no guard bits are used. The bit error rate is evaluated on a burst by burst basis. This increases the number of bits measured per unit of time and thus considerably enhances the measurement speed.

Note: *The* Burst by Burst *bit error rate test is specified for GSM phase II and phase II+ mobiles. Not all mobiles support this test mode. If a mobile does not support the* Burst by Burst *bit error rate test, the measurement fails (like for very low signal levels) and an error message*

Too many errors. Measurement halted !

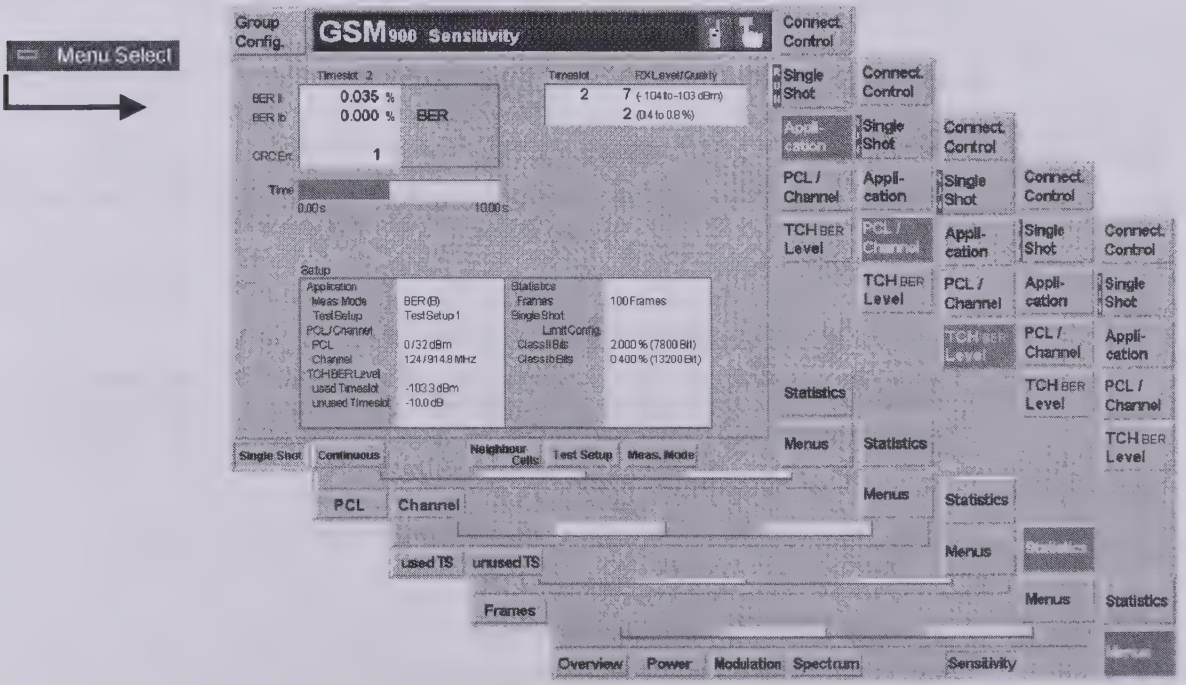
is generated.

Main Menu (Sensitivity)

The main menu *Sensitivity* shows the results and the most important parameters of the *Sensitivity* measurement.

- The main softkey Single shot (which changes to Continuous or Neighbour Cell if one of these applications is selected) indicates the status of the Sensitivity measurement (RUN, HLT, OFF) and the measurement mode and opens the configuration menu *Sensitivity Configuration.*
- The softkeys Application, PCL/Channel, TCH BER Level, Statistics, and Menus on the right softkey bar are combined with various hotkeys. When a softkey is selected and an associated hotkey pressed, a popup window appears which indicates a setting or enables an entry (see section Measurement Menu (Power) on page 4.5).
- In the tables in the center of the menu, the test settings of the current *Sensitivity* measurement and the results are displayed.

The measurement menu *Sensitivity* is opened from the main menu *Menu Select* (with the associated key at the front of the instrument) or from the menu group *GSM900/1800/1900-MS Signalling* using the hotkey *Sensitivity*.



Menu Select
Group Config.
GSM900 Sensitivity
Connect. Control
Single Shot
Appli-cation
PCL / Channel
TCH BER Level
Statistics
Menus
Single Shot
Continuous
Neighbour Cells
Test Setup
Meas. Mode
PCL
Channel
used TS
unused TS
Frames
Overview
Power
Modulation
Spectrum
Sensitivity

Timeslot 2
BER II 0.035 %
BER Ib 0.000 %
BER
CRC Err. 1
Time 0.00 s 10.00 s

Timeslot 2 RX Level/Quality 7 (-104 to -103 dBm) 2 (0.4 to 0.8 %)

Setup
Application
Meas. Mode BER (B)
Test Setup Test Setup 1
PCL/Channel
PCL 0/32 dBm
Channel 124 / 914.8 MHz
TCH BER Level
used Timeslot -103.3 dBm
unused Timeslot -10.0 dB

Statistics
Frames 100 Frames
Single Shot
Limit Config.
Class II Bits 2.000 % (7800 Bit)
Class Ib Bits 0.400 % (13200 Bit)

Fig. 4-44 Main menu Sensitivity (Single Shot)

Test Settings

Application

The *Application* softkey selects the application, test setup, and the measurement mode.

The three alternative applications *Single Shot, Continuous,* and *Neighbour Cells* are displayed in separate measurement menus. When an application is selected, the corresponding measurement menu is called up. The configuration settings for both applications, however, are listed in a common popup-menu (see p. 4.82 ff).

Single Shot and *Continuous* are treated as repetition modes in other measurement groups. The difference in the Sensitivity measurement is that the basic evaluation period is a speech frame instead of a single burst.

Single Shot

The *Single Shot* hotkey selects the single shot sensitivity measurement.

The measurement is stopped after one statistics cycle, i.e. after the number of evaluation periods (frames) set in the configuration menu *Statistics* (page 4.86) or if a stop condition is met. A measurement that has been stopped is indicated by the status display *HLT* in the associated softkey.

Single shot should always be used if only a single measurement result is required under fixed conditions.

Remote control

No explicit switchover command. All single shot measurements are identified by the 2nd/3rd level keywords `...SENSitivity:SSHot...`

Continuous

The *Continuous* hotkey selects the continuous sensitivity measurement.

The measurement runs until it is stopped explicitly, or until the stop condition is met. A continuous average over the selected number of evaluation periods (frames) is calculated. An ongoing measurement is indicated by the status display *RUN* in the associated softkey.

Remote control

No explicit switchover command. All single shot measurements are identified by the 2nd/3rd level keywords `...SENSitivity:CONTinuous...`

Neighbour Cell

The *Neighbour Cell* hotkey displays the neighbour cells reported by the mobile.

The output contains up to 6 neighbour cells together with the received signal level of signals from these cells (RxLevel, see Table 4-8 on page 4.81).

Remote control

`SENSe:RREPorts:NCELl?`

Test Setup

The *Test Setup* hotkey selects one of a maximum of ten test setups.

Test setups are single shot configuration files defined in the *Sensitivity Configuration* menu (see section *Measurement Control (Sensitivity Configuration – Control)* on page 4.82). The hotkey is not available in *Continuous* mode.

Remote control

`CONFigure:SENSitivity:SSHot:TSETup <TestSetup>`

The test setup number is denoted by a numeric suffix in the BER commands (`...SENSitivity:SSHot<nr>:...`).

Meas. Mode

The *Meas. Mode* hotkey selects the quantities to be measured.

For a list of measurement modes and corresponding measurement results see section *Measurement Results* on page 4.80 ff.

Remote control

`CONFigure:SENSitivity:SSHot<nr>:CONTrol <Mode>,<FramesToSend>`

PCL Channel

The *PCL Channel* softkey determines the mobile power and the traffic channel.

PCL

The *PCL* hotkey sets the mobile power.

The mobile power is defined in power control levels without dimension (see section *Limit Values for Average Burst Power* on page 4.68. They are indicated in the *Overview* menu (see p. 4.59).

Remote control

```
PRROCedure:SIGNalling:MS:PCL 0 ... 31
```

Channel

The *Access* hotkey sets the number of the traffic channel.

The channel number is also indicated in the *Overview* menu (see p. 4.59). For an overview of GSM channel structure see tables in section *Control of Input and Ouput Signals* on page 4.37.

Remote control

```
PROCedure:SIGNalling[:TCH]:CHANnel <number>
```

TCH BER Level

The *TCH BER Level* softkey defines the level in the used timeslot and in the unused timeslots of the traffic channel (for applications *Single Shot* and *Continuous*

The definitions remain valid for the duration of the sensitivity measurement only, see section *Measurement Control (Sensitivity Configuration – Control)* on page 4.82.

Used TS

The *Used TS* hotkey sets the absolute TCH level (in dBm) in the used timeslot.

Remote control

```
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:CONTrol[:TCH]:
          LEVel:UTIMeslot <Level>
```

Unused TS

The *Unused TS* hotkey sets the TCH level in the unused timeslots.

The unused TS level is expressed in units relative to the level in the used timeslot. Note that the sensitivity specifications defined in GSM 05.05 must be met when the two timeslots adjacent to the used timeslot are detecting GSM signals at 20 dB above the used timeslot level. This is why the default value for the unused TS level is higher than the default used TS level.

Remote control

```
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:CONTrol[:TCH]:
          LEVel:UNTimeslot <Level>
```

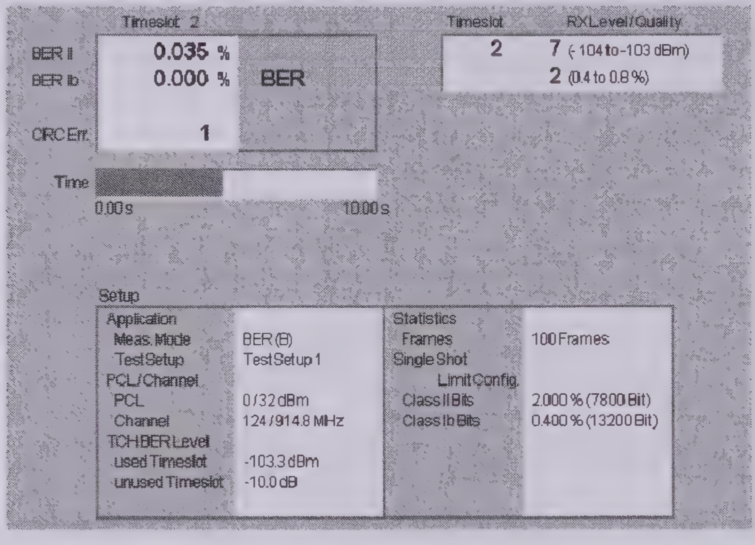
Statistics

The *Statistics* softkey defines the frames to send in a *Single Shot* measurement and the frames to average in a *Continuous* measurement.

The settings are identical with the ones provided in the *Statistics* index card of the *Sensitivity Configuration* menu, see page 4.86.

Measurement Results

The test settings of the current *Sensitivity* measurement and the results are displayed in the tables in the center of the menu.



Timeslot 2
BER II 0.035 %
BER Ib 0.000 %
CRC Err. 1

Timeslot	RX Level/Quality
2	7 (-104 to -103 dBm) 2 (0.4 to 0.8 %)

Setup

Application	
Meas. Mode	BER (B)
Test Setup	Test Setup 1
PCL/Channel	
PCL	0 / 32 dBm
Channel	124 / 914.8 MHz
TCH BER Level	
used Timeslot	-103.3 dBm
unused Timeslot	-10.0 dB

Statistics	
Frames	100 Frames
Single Shot	
Limit Config.	
Class II Bits	2.000 % (7800 Bit)
Class Ib Bits	0.400 % (13200 Bit)

Fig. 4-45 Display of test settings and measurement results (Single Shot)

The measurement results in the left upper table to depend on the selected measurement mode (see definitions at the beginning of section *Sensitivity* on page 4.76).

RBER/FER

When the residual bit error rate *(Meas. Mode = RBER/FER)* is measured the following is displayed:

RBER II	Residual bit error rate for class II bits (unprotected bits)
RBER Ib	Residual bit error rate for class Ib bits (partly protected bits)
FER	Frame erasure rate: relative number of invalid and therefore erased frames
CRC Error	Result of *cyclic redundancy check*. Number of frames erased on the signal path from the device under test to the CMU

BER

When the bit error rate *(Meas. Mode = BER)* is measured the following is displayed:

BER II	Bit error rate for class II bits (unprotected bits)
BER Ib	Bit error rate for class Ib bits (partly protected bits)
CRC Error	Result of *cyclic redundancy check:* number of frames erased on the signal path from the device under test to the CMU

Burst by Burst

In a *Burst by Burst* mesurement (Fast BER, *Measure Mode = Burst by Burst),* the following is displayed:

BER	Bit error rate for class II bits (unprotected bits, no other bits are transmitted)
CRC Error	Result of *cyclic redundancy check:* number of frames erased on the signal path from the device under test to the CMU

A bar below the table indicates the relative measurement progress:

- In a *single shot* measurement, the ratio between the current measurement time and the total measurement time.
- In a *continuous* measurement, the ratio between the frames measured and the total number of frames to be measured.

Remote Control

```
READ[:SCALar]:SENSitivity:SSHot|CONTinuous[:RESult?]
FETCh[:SCALar]:SENSitivity:SSHot|CONTinuous[:RESult]?
SAMPle[:SCALar]:SENSitivity:SSHot|CONTinuous[:RESult]?
```

Setup

The table *Setup* gives an overview of the configuration of the current measurement. This includes the settings made via the softkeys and hotkeys of the *Sensitivity* menu, and the tolerances set in the *Limits* index card of the *Sensitivity Configuration* menu, see p. 4.85.

The parameters depend on the current application and the measurement mode.

Remote control

See sections *Test Settings* on page 4.78 and *Upper Limits for Bit Error Rate (Sensitivity Configuration – Limits)* on p. 4.85.

MS Rcv. Reports – Received Results of the Mobile Phone

GSM mobile phones continuously measure the signal strength and quality of several nearby base stations. The measured values for the active base station (serving cell BTS) are regularly sent to the active base station (in this case: the CMU) in the so-called "measurement reports". They are thus automatically provided and do not represent real measured quantities.

The quantities characterizing the signal strength and quality of the serving cell (i.e. the CMU's traffic channel signal) are displayed together with the used TCH timeslot number in a table in the upper right part of the *Sensitivity* menu.

RX Level

The output window *RX Level* indicates the received signal input level determined by the mobile for the signals of the CMU.
The level is expressed in terms of dimensionless power levels depending linearly on the absolute measured power. A high power level implies a high received signal input power:

Table 4-8 Definition of RX Level

Value of RX Level	Corresponding signal strength
63	> –48 dBm
62	–49 dBm to –48 dBm
62	–50 dBm to –49 dBm
...	...
2	–109 dBm to –108 dBm
1	–110 dBm to –109 dBm
0	< –110 dBm

Remote control

```
SENSe:RREPorts:RXLevel?
```

RX Quality The output window *RX Quality* indicates the received signal quality determined by the mobile for the signals of the CMU.

The received signal quality is expressed in terms of dimensionless quality levels (actually "error levels") depending linearly on the logarithm of the bit error rate. A high quality level implies a high bit error rate and thus a **poor** received signal quality:

Table 4-9 Definition of RX Quality

Value of RX Quality	Bit error rate
0	0% to 0.2%
1	0.2% to 0.4%
2	0.4% to 0.8%
3	0.8% to 1.6%
4	1.6% to 3.2%
5	3.2% to 6.4%
6	6.4% to 12.8%
7	12.8% to 100%

Remote control `SENSe:RREPorts:RXQuality?`

The receiver reports of up to six neighbour cells of the serving cell can be displayed using the *Neighbour Cell* hotkey, see page 4.78.

Measurement Configurations (Sensitivity Configuration)

The popup menu *Sensitivity Configuration* contains three index cards which determine the parameters for measurement of the bit error rate.

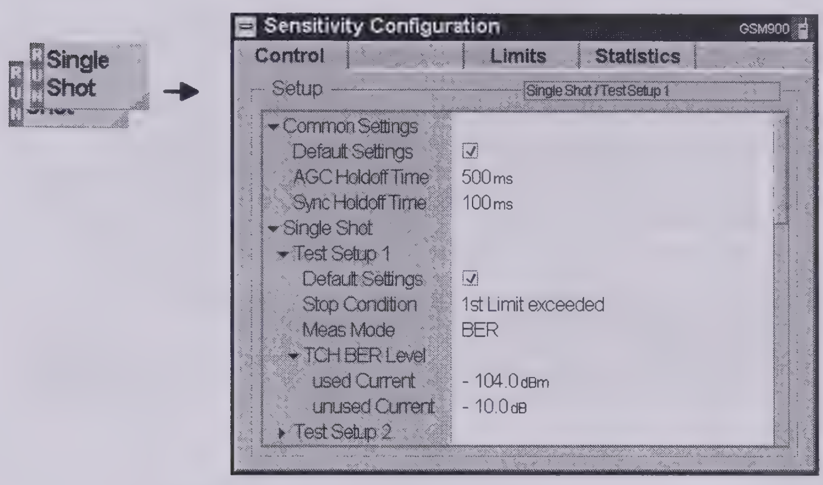
The popup menu *Sensitivity Configuration* is opened by pressing the softkey *Sensitivity Continuous* at the top right in the main menu *Sensitivity* twice. It is possible to change between the index cards by pressing the associated hotkeys.

Measurement Control (Sensitivity Configuration – Control)

The index card *Control* controls the Sensitivity measurement by determining

- Settling times for the mobile after which the measurement is started *(AGC/Sync. Holdoff Time)*
- The *Repetition* mode
- The *Stop Condition* for the measurement
- The measured quantity *(Meas. Mode)*
- The level in the traffic channel *(TCH BER Level)* set during the *Sensitivity* measurement

With the exception of the holdoff times, all settings can be defined separately for the two applications *Single Shot* (with up to ten different test setups) and *Continuous*.



Setup: Single Shot / Test Setup 1

Common Settings
Default Settings ☑
AGC Holdoff Time 500 ms
Sync Holdoff Time 100 ms
Single Shot
Test Setup 1
Default Settings ☑
Stop Condition 1st Limit exceeded
Meas Mode BER
TCH BER Level
used Current - 104.0 dBm
unused Current - 10.0 dB
Test Setup 2

Fig. 4-46 Sensitivity – Control

Default

The first *Default* switch overwrites all settings in the *Control* index card with default values. Besides, there are default switches acting on every individual single shot test setup and on the continuous mode.

Remote control

```
CONFigure:SENSitivity:CONTrol:DEFault  ON | OFF
CONFigure:SENSitivity:SSHot<nr>:CONTrol:DEFault  ON | OFF
CONFigure:SENSitivity:CONTinuous:CONTrol:DEFault  ON | OFF
```

Holdoff Times

The *Holdoff Time* parameters specify delay times necessary for the adjustment of the mobile station to the BER measurement and the loop-back of the bit stream.

AGC Mobile	Time during which the mobile can adjust itself to the new RF level at the beginning of the Sensitivity measurement (automatic gain control). The *AGC Holdoff Time* is also applied if the RF level changes during the *Sensitivity* measurement.
Bit Stream Synch.	Delay time after which the signalling unit of the CMU starts synchronizing to the bit stream. This holdoff time is not applied in the case of RF level changes during the *Sensitivity* measurement.

Both hold off times depend on the performance of the mobile station. A reduction of the hold off times towards their mobile-dependent lower limits can accelerate the measurement.

Remote control

```
CONFigure:SENSitivity:CONTrol:HTIMe <AGCTime>,<SynchTime>
```

Test Setup

The list field *Test Setup* permits definition, storage and later activation of up to 10 user-specific configuration files for single shot sensitivity measurements. The applications are numbered from 1 to 10 and can be called up via the *Test Setup* hotkey associated to the *Application* softkey. They differ from each other in the default settings for the signal power of the CMU and the criteria for analysis.

Remote control

The application number is denoted by a numeric suffix in the Sensitivity commands `(...SENSitivity:SSHot<nr>:...)`.

Stop Condition

The *Stop Condition* parameter defines a stop condition for the measurement:

NONE	Continue measurement even in case of error
1st Limit exceeds	Stop measurement on first error (tolerance exceeded)
All Limits exceeds	Stop measurement if all tolerances are exceeded

Remote control

```
CONFigure:SENSitivity:SSHot<nr>:CONTrol:REPetition
        ALIMits | FLIMit | NONE,<StepMode>
```

```
CONFigure:SENSitivity:CONTinuous:CONTrol:REPetition
        ALIMits | FLIMit | NONE,<StepMode>
```

Meas. Mode

The *Meas. Mode* parameter determines the measured quantity:

BER	Bit error rate (separately for class II and class Ib bits)
RBER/FER	Residual bit error rate (separately for class II and class Ib bits) and frame erasure rate
Burst by Burst	Accelerated measurement, only class II bits are transmitted

All measured quantities are defined at the beginning of section *Sensitivity Measurements* on page 4.76 ff.

```
CONFigure:SENSitivity:SSHot<nr>:CONTrol:MODE
        RFER | BER | BBB,<FramesToSend>
CONFigure:SENSitivity:CONTinuous:CONTrol:MODE
        RFER | BER | BBB,<FramesToSend>
```

TCH BER Level

The *TCH BER Level* parameter defines the level in the traffic channel by means of the following specifications:

used Current	Absolute level in the used timeslot of the traffic channel, valid during the sensitivity measurement only,
unused Current	Level in the unused timeslots of the traffic channel relative to the level in the used timeslot.

The level in the used timeslot is specified in dBm. The permissible value range depends on the selected RF output of the CMU and the external attenuation set.

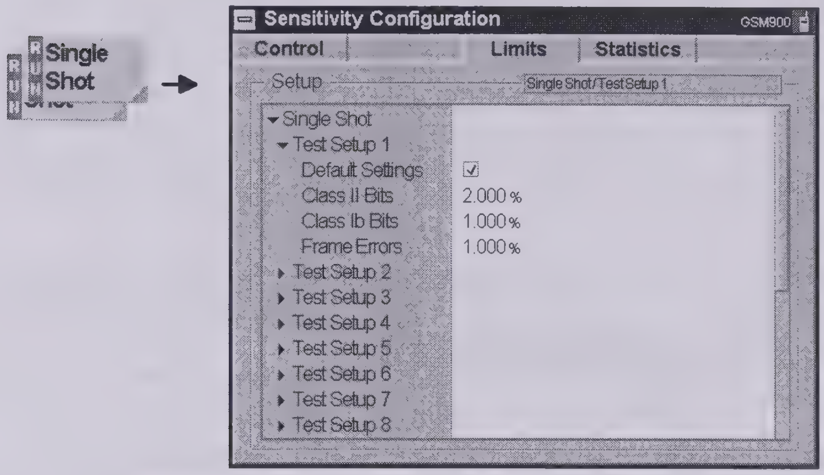
The level in the unused timeslots is specified relative to the level in the used timeslot in the unit dB. The actual level in the unused timeslots must also lie within the permissible range for the RF outputs. This condition may place an additional restriction on the permissible maximum level for the unused timeslots.

Remote control

```
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:CONTrol[:TCH]:
        LEVel:UTIMeslot <Level>
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:CONTrol[:TCH]:
        LEVel:UNTimeslot <Level>
```

Upper Limits for Bit Error Rate (Sensitivity Configuration – Limits)

The index card *Limits* defines the upper limits for the individual measured quantities in the sensitivity menu. All settings can be defined separately for the two applications *Single Shot* (with up to ten different test setups) and *Continuous.* Which of the configured quantities are actually measured depends on the measurement mode set *(BER, RBER/FER,* or *Burst by Burst,* see section Measurement Results on page 4.80).



- Single Shot
  - Test Setup 1
    - Default Settings ☑
    - Class II Bits 2.000 %
    - Class Ib Bits 1.000 %
    - Frame Errors 1.000 %
  - Test Setup 2
  - Test Setup 3
  - Test Setup 4
  - Test Setup 5
  - Test Setup 6
  - Test Setup 7
  - Test Setup 8

Fig. 4-47 Sensitivity Configuration – Limits

Default Settings The *Default* switches overwrite the settings belonging to an individual single shot test setup or to the continuous mode.

Remote control
```
CONFigure:SENSitivity:SSHot<nr>:LIMit:DEFault  ON | OFF
CONFigure:SENSitivity:CONTinuous:LIMit:DEFault  ON | OFF
```

Class II Bits Upper limit of the bit error rate (or residual bit error rate or burst by burst bit error rate, depending on the mode) for class II bits (unprotected bits) in the value range 0% ... 100%.

Class Ib Bits Upper limit of the bit error rate (or residual bit error rate, depending on the mode) for class Ib bits (partly protected bits) in the value range 0% ... 100%.

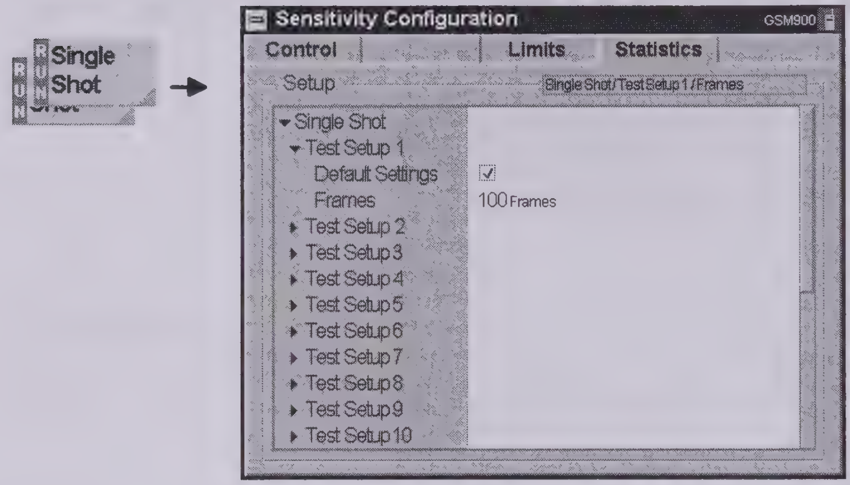
Frame Errors Upper limit for frame error rate (frame erasure rate), relative number of invalid and therefore erased frames in the value range 0% ... 100% (only measured in measurement mode RBER/FER).

The default settings for the three upper limits reflect the importance of the three measured quantities for evaluation of the transmission and received-signal quality (in the case of unprotected bits, a higher error rate is expected and accepted than in the case of protected bits, etc.).

Remote control
```
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:LIMit:CLII <Error>
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:LIMit:CLIB <Error>
CONFigure:SENSitivity:SSHot<nr>|CONTinuous:LIMit:FERRors
                                            <Error>
```

Scope of Measurement (Sensitivity Configuration – Statistics)

The index card *Statistics* determines the scope of measurement, i.e. the number of frames to be sent in a single shot *Sensitivity* measurement and the number of frames to be averaged in a continuous measurement.


RUN
Single Shot
Sensitivity Configuration
GSM900
Control
Limits
Statistics
Setup
Single Shot/Test Setup 1/Frames
Single Shot
Test Setup 1
Test Setup 2
Test Setup 3
Test Setup 4
Test Setup 5
Test Setup 6
Test Setup 7
Test Setup 8
Test Setup 9
Test Setup 10

Default Settings ☑

Frames 100 Frames

Fig. 4-48 Sensitivity Configuration – Statistics

Default Settings	The *Default* switches overwrite the settings belonging to an individual single shot test setup or to the continuous mode.
Remote control	`CONFigure:SENSitivity:SSHot<nr>:CONTrol:DEFault ON | OFF` `CONFigure:SENSitivity:CONTinuous:CONTrol:DEFault ON | OFF`
Frames	The parameter *Frames* defines the statistic count (= the number of frames to be sent in a single shot measurement). A low value permits to limit the scope and accelerate the measurement.
Remote control	`CONFigure:SENSitivity:SSHot<nr>:CONTrol <Mode>,<FramesToSend>`
Average	The parameter *Average* defines the number of frames to be averaged in a continuous measurement.
Remote control	`CONFigure:SENSitivity:CONTinuous:CONTrol <Mode>,<FramesToAverage>`

Popup Menu Connection Control

The menu group *Connection Control* controls the signalling procedures (call setup and release, services, signalling parameters) and determines the inputs and outputs with the external attenuation values and the reference frequency.

As the *Signalling* measurements are typically (or exclusively) performed with a call connection to the mobile station, the menus for setting up the call (*Connection Control – Signalling)* appear immediately after selection of the function group *GSM900/1800/1900-MS Signalling* in the *Menu Select* menu. Besides, all the menus of the group *Connection Control* can be accessed any time by pressing the softkey *Connect. Control* at the top right in every measurement menu. They are linked with each other via the hotkey bar at the lower edge of the screen. By pressing the *Escape* key, the active *Connection Control* menu is closed and the CMU changes to the measurement mode.

The index cards *Connection Control – Signalling* displayed during synchronization are described at the beginning of section *GSM Measurements with Signalling* on p. 4.51 ff. The remaining index cards of the *Connection Control – Signalling* menu are described in the following.

Signalling Control with Call Established (State Call Established)

The popup menu *Signalling (Call Established)* provides information on

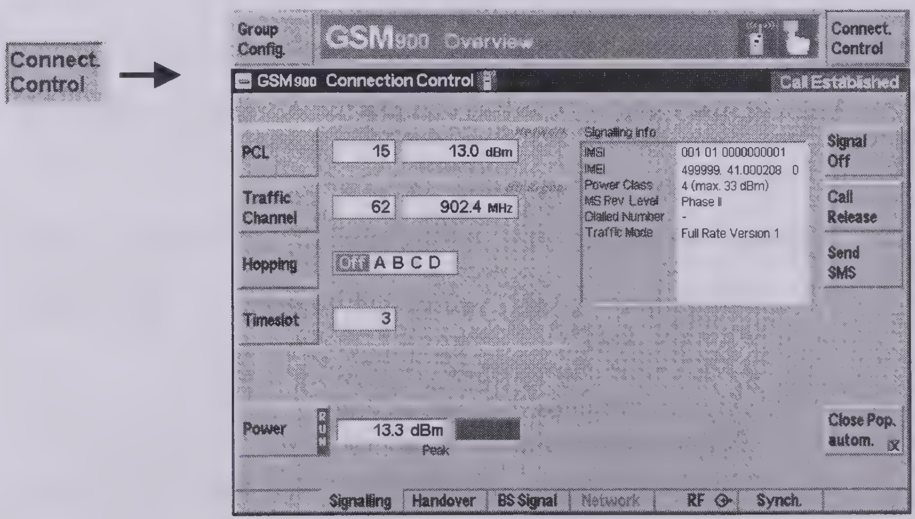
- The signalling parameters of the mobile station *(Signalling Info)*
- The status and result of the peak power measurement *(Power)*

It contains softkeys which lead to different signalling states:

- Deactivation of the signal for synchronization and call release to the mobile station *(Signal Off)*
- Call release to mobile station (*Call Release* state *Synchronized)*
- Short message service *(Send SMS* return to state *Call Established)*

It permits the following network and signal parameters to be entered:

- Transmitter power of mobile station *(PCL)*
- Number and frequency of the *Traffic Channel* signal generated by the CMU
- Frequency *Hopping* sequence
- *Timeslot* number of the traffic channel



PCL 15 13.0 dBm
Traffic Channel 62 902.4 MHz
Hopping Off A B C D
Timeslot 3
Power RUN 13.3 dBm Peak

Signalling Info

IMSI	001 01 0000000001
IMEI	499999. 41.000208 0
Power Class	4 (max. 33 dBm)
MS Rev Level	Phase II
Dialled Number	-
Traffic Mode	Full Rate Version 1

Fig. 4-49 Connection Control – Signalling (Call Established)

The function of the softkeys *Signal Off* and *Power* is described in section *Signalling Control without Signal* on page 4.52, the *Send SMS* softkey in section *Signalling Control with Signal* on page 4.54.

The *Network* panel contains the *PCL* softkey.

PCL

The *PCL* softkey controls the transmit power of the mobile station.

For the definition of the PCL power control levels see section *Limits for the Average Burst Power* on page 4.68.

Remote control `CONFigure:NETWork[:MS]:POWer <Level>`

The panel *BS Signal* contains three softkeys which are used for configuration of the CMU's signals.

Traffic Channel

The *Traffic Channel* softkey determines the number of the traffic channel.

The parameters for the traffic channel are described in summary in section *BS Signal Parameters (State Signal Off/On,* Synchronized) on page 4.92. For an overview of GSM channels see section *Control of Input and Output Signals* on page 4.37.

Remote control `CONFigure:BSSignal[:TCH]:CHANnel <Channel>`

Hopping

The *Hopping* softkey opens the popup menu used to select a frequency hopping sequence.

Off	Switch off frequency hopping
A, B, C, D	Selection of the hopping sequence referred to as A (or B or C or D)

Note: *The hopping sequence can be (re)defined in the signalling states Signal Off, Signal On, and Synchronized using the BS Signal index card of the Connection Control menu.*

Remote control `PROCedure:BSSignal[:TCH]:FHOPPing:SEQuence A| B| C| D| OFF`

Timeslot

The *Timeslot* softkey determines the used timeslot of the traffic channel.

The parameters for the traffic channel are described in summary in section *BS Signal Parameters (State Signal Off/On,* Synchronized) on page 4.92.

Remote control `CONFigure:BSSignal[:TCH]:TIMeslot <number>`

Signalling Info The table *Signalling Info* indicates the characteristics of the connected mobile station:

IMSI	*international mobile subscriber identity* in the format MCC.MNC.MSIN
MCC	3-digit *mobile country code*
MNC	2-digit *mobile network code*
MSIN	10-digit *mobile subscriber id. no.*
IMEI	*international mobile station equipment identity* in the format TAC.FAC.SNR.SVN
TAC	6-digit *type approval code*

FAC	2-digit *final assembly code*
SNR	6-digit *serial no.*
SVN	1|2-digit *software version number*
Power Class	Power class of mobile station in PCL power control levels, see section *Limits for the Average Burst Power* (*Measurement Menu Power vs Time)* on page 4.68.
MS Rev. Level	GSM phase of mobile station
Dialled Number	Number dialed at the mobile station (*Call from MS)*
Traffic Mode	Mode in the traffic channels

The traffic mode is a network parameter which, depending on the speech coder of the mobile station, can be set in the *Network* menu.

Remote control

```
SENSe:MSSinfo:IMSI:MCC?
SENSe:MSSinfo:IMSI:MNC?
SENSe:MSSinfo:IMSI:MSIN?
SENSe:MSSinfo:IMEI:TAC?
SENSe:MSSinfo:IMEI:FAC?
SENSe:MSSinfo:IMEI:SNR?
SENSe:MSSinfo:IMEI:SVN?
SENSe:MSSinfo:POWer:CLASs?
SENSe:MSSinfo:REVision?
SENSe:MSSinfo:DNUMber?
SENSe:MSSinfo:TRAFfic?
```

Call Release

The *Call Release* softkey releases the call to the mobile station. The CMU changes to the signalling state *Synchronized.*

Remote control

```
PROCedure:SIGNalling:ACTion CRELease
```

Close Pop. autom. ☐

The softkey *Close Pop. autom.* contains a button which can be used to close the menu *Signalling (Call Established)* automatically when a call is set up.

- In the default setting (*Close Pop. autom.* on), the popup menu is closed as soon as the signalling state *call established* is reached or a handover is performed.
- In the alternative setting (*Close Pop. autom.* off), the popup-menu must be closed explicitly (e.g. via the *Escape* key) to continue the measurement.

Remote control –

Handover to another Network (Connection Control – Handover)

The *Handover* index card initiates a handover of the call connection to a different network. This includes:

- Selection of the target network *(Destination Selection)* and the handover parameters *(Destination Parameter, Destination Defaults)*
- Start of the handover procedure *(Handover)*
- Display and modification of the parameters of the original network *(Origin Parameter)*

Connect. Control →

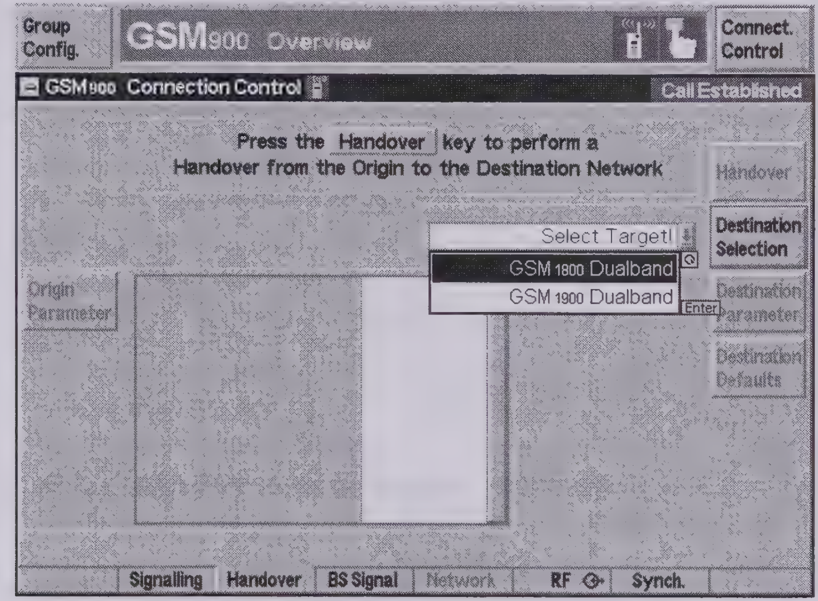

Group Config.
GSM900 Overview
Connect. Control
GSM900 Connection Control
Call Established
Press the Handover key to perform a Handover from the Origin to the Destination Network
Handover
Select Target!
Destination Selection
GSM 1800 Dualband
GSM 1900 Dualband
Enter
Origin Parameter
Destination Parameter
Destination Defaults
Signalling
Handover
BS Signal
Network
RF
Synch.

Fig. 4-50 Connection Control – Handover (Call Established)

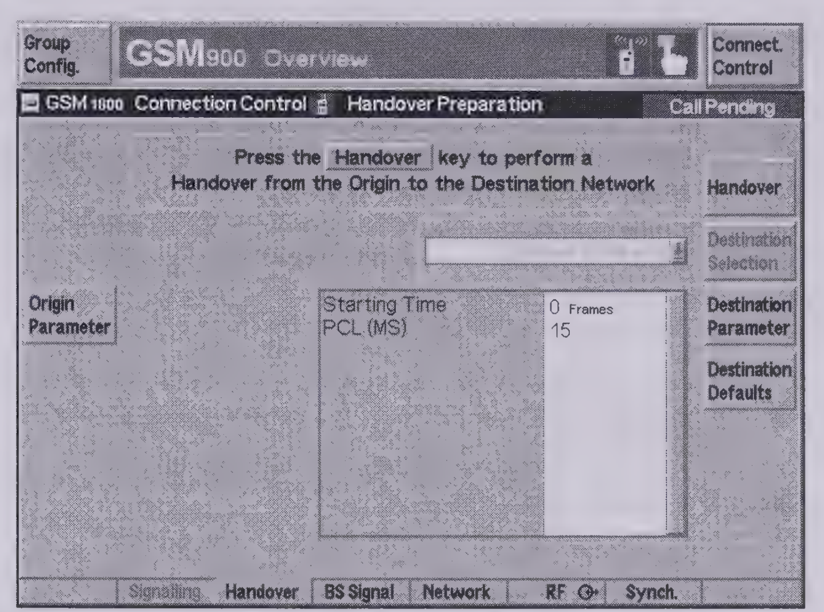
Destination Selection

The softkey *Destination Selection* selects the target network for handover.

Within function group *GSM900/1800/1900-MS*, dual band handover between GSM900/GSM1800 and between GSM900/GSM1900 is provided. Once the selection is confirmed via *Enter,* the remaining softkeys of the index cards are active:

Remote control

```
STATus:HANDover:TARGet:LIST?
CONFigure:HANDover:TARGet <Target>
```


Group Config.
GSM900 Overview
Connect. Control
GSM 1800 Connection Control
Handover Preparation
Call Pending
Handover
Destination Selection
Origin Parameter
Destination Parameter
Destination Defaults
Signalling
Handover
BS Signal
Network
RF
Synch.

Press the Handover key to perform a Handover from the Origin to the Destination Network

Starting Time 0 Frames
PCL (MS) 15

Fig. 4-51 Connection Control – Handover (Call Pending)

Destination Parameter

The *Destination Parameter* softkey sets the parameters of the target network for handover.

Starting Time	Time interval (in frames) after which the mobile station performs a new registration with the base station after a channel, timeslot, and fast power change.
PCL (MS)	Power control level used by the mobile station to call and perform a location update in the target network.

See also section Network Parameters (Connection Control – Network) on page 4.96 ff.

Remote control

```
CONFigure:NETWork:SMODe:STIMe <Frames> | OFF
CONFigure:NETWork[:MS]:POWer <PCL>
```

Destination Defaults

The *Destination Defaults* softkey sets the parameters of the target network to default values.

Remote control

```
CONFigure:NETWork:SMODe:STIMe DEF
CONFigure:NETWork[:MS]:POWer DEF
```

Handover

The *Handover* initiates handover to the target network.

Remote control

```
PROCedure:SIGNalling:ACTion HANDover
```

Origin Parameter

The *Origin Parameter* softkey sets the parameters of the original network.

Remote control

```
CONFigure:NETWork:SMODe:STIMe DEF
CONFigure:NETWork[:MS]:POWer DEF
```

Signals of the CMU (Connection Control – BS Signal)

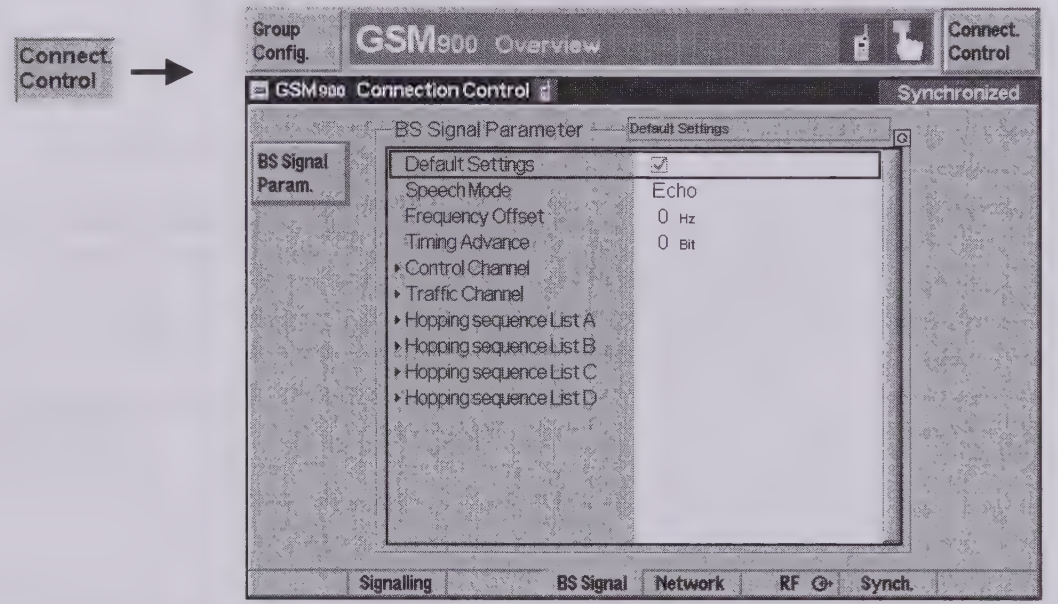
The *BS Signal* index card configures the signals of the CMU (which simulates a base station transmitting a control channel and a traffic channel signal), selects frequency offset, frequency hopping method and transmit data and indicates the transmission parameters. The range of functions of the menu depends on the signalling state:

- Signal settings must be performed before a call is set up to the mobile station. They are available in the signalling states *Signal Off, Signal On,* and *Synchronized.*
- Parameters of the mobile station are only available after the call has been set up, i.e. in the signalling state *Call Established.*

BS Signal Parameters (State Signal Off/On, Synchronized)

The *BS Signal* index card configures the signals of the CMU. This includes:

- The parameters of the control and traffic channels
- Input of a frequency offset and selection of the transmit data (speech mode)



BS Signal Parameter — Default Settings

Default Settings	☑
Speech Mode	Echo
Frequency Offset	0 Hz
Timing Advance	0 Bit
▸ Control Channel	
▸ Traffic Channel	
▸ Hopping sequence List A	
▸ Hopping sequence List B	
▸ Hopping sequence List C	
▸ Hopping sequence List D	

Fig. 4-52 Connection Control – BS Signal (Signal On)

BS Signal Param.

The softkey *BS Signal Param.* activates the input of parameters for the signals sent by the CMU.

The control and traffic channels are configured separately. Besides, a general frequency offset can be entered and the speech mode selected.

Default Settings

The *Default* switch assigns default values to all parameters of the popup menu *BS Signal (Signal On).*

Speech Mode

The table line *Speech Mode* determines the data transmitted on the traffic channel.

Echo Loop-back mode with delay. The CMU sends back all data received on the TCH after 50 speech frames (Echo). If the CMU does not receive speech data in this operating mode, a bit pattern is automatically sent, producing "silence" in the receiver of the mobile station.

Loopback	Loop-back mode with minimum delay: The CMU sends back all data received on the TCH after 1 speech frame.
PSR 2E9-1	Transmission of the pseudo random sequence to CCITT O.153
PSR 2E11-1	Transmission of the pseudo random sequence to CCITT O.153
PSR 2E15-1	Transmission of the pseudo random sequence to CCITT O.151
PSR 2E16-1	Transmission of a pseudo random sequence (Polynomial: $x^{16}+x^5+x^3+x^2+1$)
Handset	The CMU sends a bit pattern generated by an analog signal on the speech coder/decoder (*Speech* connector at the front panel of the instrument).

In a bit-error-rate measurement one of the pseudo random sequences must be used. If no pseudo random sequence is selected when a Sensitivity measurement is activated the CMU automatically switches over to *PSR 2E16-1.*

Remote control

```
CONFigure:BSSignal:SPEech
               ECHO | LOOP | PR9 | PR11 | PR15 | PR16 | HANDset
```

Frequency offset The table line *Frequency Offset* determines the frequency offset of the CMU signals from the value defined under *RF Channel.* This enables fine tuning of the signal generated by the CMU, for example for correction of a Doppler shift (due to a relative movement between mobile and CMU) or de-tuning of the mobile.

Remote control

```
CONFigure:BSSignal:FREQuency:OFFset  <Frequency>
```

Timing Advance The table line *Timing Advance* sets a (positive) delay time (in bit) correcting the timing of the mobile. Timing advance is to compensate for the propagation time of the signal between the base station (CMU) and the mobile.

Remote control

```
CONFigure:BSSignal[:TCH]:TIMing:ADVance <Delay>
```

Control channel The section *Control Channel* contains the parameters for the control channel used for synchronization of the mobile.

RF Channel	Number of control channel. For an overview of GSM channels see section *Control of Input and Output Signals* on page 4.37
Level	Level of control channel

The permissible value range for *Level* depends on the RF output selected and of the external attenuation set.

Remote control

```
CONFigure:BSSignal:CCH:CHANnel <CCHChannel>
CONFigure:BSSignal:CCH:LEVel:ABSolute  <Level>
```

Traffic channel The section *Traffic Channel* contains the parameters for the traffic channel (cf. softkey *RF Channel.*

RF Channel	Number of traffic channel. For an overview of GSM channels see section *Control of Input and Output Signals* on page 4.37.
Timeslot	Number of (used) timeslot
Used Timeslot Level	Level in the used timeslot of the traffic channel
Unused Timeslot	Level in the unused timeslots of the traffic channel

The permissible value range for *Used Timeslot Level* depends on the RF output selected and of the external attenuation set, see above *(Control channel)* and section *Control of Input and Output Signals (Non Signalling).*

The *Unused Timeslot Level* is always indicated relative to the *Used Timeslot Level.* Again make sure that the maximum permissible level at the selected RF output is not exceeded.

Remote control

```
CONFigure:BSSignal[:TCH]:CHANnel <TCHChannel>
CONFigure:BSSignal[:TCH]:TIMeslot  <Timeslot>
CONFigure:BSSignal[:TCH]:LEVel:UTIMeslot  <Level>
CONFigure:BSSignal[:TCH]:LEVel:UNTimeslot  <Level>
```

Hopping List... The table section *Hopping List...* displays and configures the frequency hopping table. Configured hopping sequences can be selected via the *Hopping* softkey in the signalling state *Call Established* (page 4.88).

Frequency hopping is used for error protection in the radio transmission path, switching over the transmission channels algorithmically to other carrier frequencies. The dwell time at a frequency is 4.615 ms in GSM. To define frequency hopping, a hopping sequence (hopping list) must be reported to the mobile station.

Four standard hopping lists *A, B, C,* and *D* are defined for GSM, see command description in chapter 6. All four lists can be modified by entering up to 64 channel numbers. A list may consist of less than 64 channels; in this case, *OFF* is entered for the channel numbers not assigned.

List Sorted The *List Sorted* switch arranges the channel numbers of a hopping list in ascending order.

Remote control

```
CONFigure:BSSignal[:TCH]:FHOPping:A|B|C|D <Channel1>,...
```

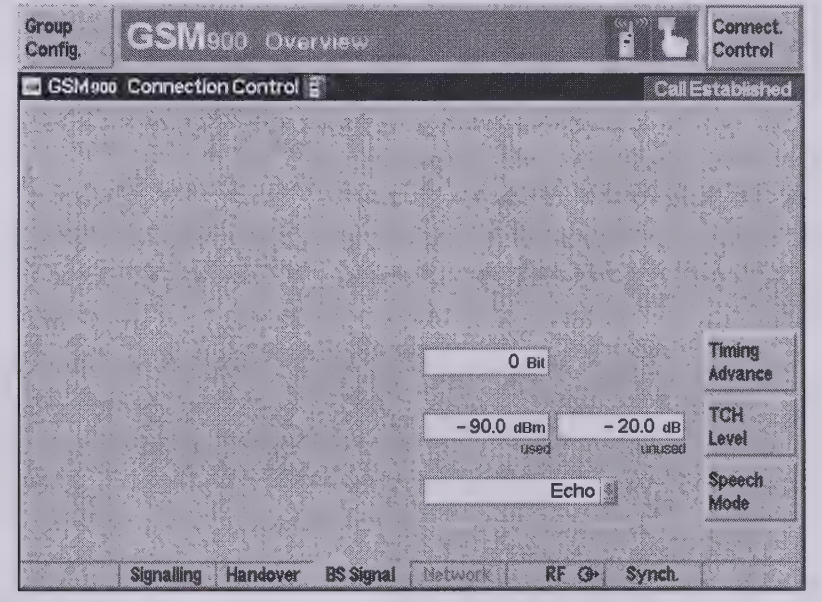
BS Signal Parameters (State Call Established)

The popup menu *BS Signal* indicates the transmission parameters in the traffic channel. These include

- The reported *Timing Advance,*
- The signal level in the traffic channel (T*CH Level),*
- The *Speech Mode.*

The receiver reports of the mobile station are indicated in the *Sensitivity* menu.

Connect. Control →


Group Config.
GSM900 Overview
Connect. Control
GSM900 Connection Control
Call Established
Timing Advance
TCH Level
Speech Mode
Signalling
Handover
BS Signal
Network
RF
Synch.

0 Bit

-90.0 dBm used

-20.0 dB unused

Echo

Fig. 4-53 Connection Control – BS Signal (Call Established)

Timing Advance

The *Timing Advance* softkey sets a (positive) delay time (in bit) correcting the timing of the mobile.

Timing advance is to compensate for the propagation time of the signal between the base station (CMU) and the mobile.

Remote control `PROCedure:BSSignal[:TCH]:TIMing:ADVance <Delay>`

TCH Level

The *TCH Level* softkey enables the levels to be entered in the used and unused timeslots of the traffic channel.

The current values are displayed in the input field. See section *BS Signal Parameters (State Signal Off/On,* Synchronized) on page 4.92.

Remote control

```
PROCedure:BSSignal[:TCH]:LEVel:UTIMeslot <Level>
PROCedure:BSSignal[:TCH]:LEVel:UNTimeslot <Level>
```

Speech Mode

The softkey *Speech Mode* activates the selection of the speech mode of the CMU.

The currently selected mode is displayed in the input field. See section *BS Signal Parameters (State Signal Off/On,* Synchronized) on page 4.92.

Remote control `PROCedure:BSSignal:SPEech:MODE <Mode>`

Network Parameters (Connection Control – Network)

The popup menu *Network* defines various parameters of the network and the mobile station. This includes

- *Network Identity*
- Configuration parameters for signalling *(Location Update, Default IMSI, Power Change, Signalling Channel, Traffic, Loop Command, Starting Time)*
- The definition of the parameters of the mobile station that are requested by the CMU during *location update* or when a call is setup *(Requested Mobile Data)*
- *Mobile Settings*
- *System Parameters*
- *Timeouts*
- The used channels in the neighbor cells *(BA List)*
- Parameters for calculation of the *Advice of Charge*

Note: *This menu is not available in the* Call Established *signalling state. If the mobile station sets up a call while the* Network *menu is active, the CMU automatically switches over to the Signalling menu (see p. 4.87).*

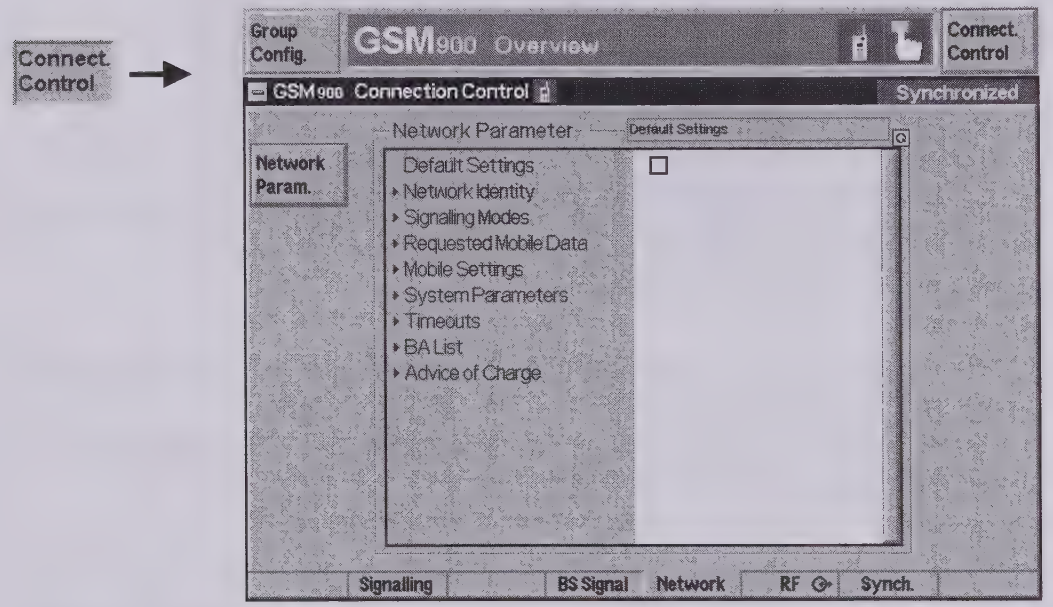

Connect.
Control
Group
Config.
GSM900 Overview
Connect.
Control
GSM900 Connection Control
Synchronized
Network
Param.
Network Parameter
Default Settings
Default Settings ☐
Network Identity
Signalling Modes
Requested Mobile Data
Mobile Settings
System Parameters
Timeouts
BA List
Advice of Charge
Signalling
BS Signal
Network
RF
Synch.

Fig. 4-54 Connection Control – Network parameters

Network Parameter The *Network Parameter* softkey activates the associated table for entering or selecting various parameters of the network and the mobile station.

Network Identity The field *Network Identity* contains parameters characterizing the radio network:

MCC	3-digit mobile country code, set to 001,
MNC	2-digit mobile network code, set to 01,
NCC	Network color code, set to 0,
BCC	Base transceiver station color code, set to 0,
Location Area	Location area code, set to 1.

Remote control

```
CONFigure:NETWork:IDENtity:MCC   <MCC>
CONFigure:NETWork:IDENtity:MNC   <MNC>
CONFigure:NETWork:IDENtity:NCC   <NCC>
```

```
CONFigure:NETWork:IDENtity:BCC  <BCC>
CONFigure:NETWork:IDENtity:LAC  <LAC>
```

Signalling Modes

The *Signalling Modes* field determines signalling parameters that are sent to the mobile station by the CMU and that refer to its function (the parameters for CMU signals, on the other hand, are set in the popup menu BS-Signal, see section *BS Signal Parameters (State Signal Off/On, Synchronized)* on page 4.90). The parameters refer to:

- *Location Update*
- Input of a mobile subscriber identity used for the location update *(Default IMSI)*
- *Power Change* mode
- *Signalling Channel*
- Speech coding *(Traffic)*
- Condition for closing the loop in the mobile station *(Loop Command)*
- Definition of a *Starting Time* for the channel change and the handove.

Location Update

The line *Location Update* determines in which cases the mobile performs a location update:

Always	each time the mobile station is switched on

A location update is normally used to signal to the base stations that the mobile station has changed its position. In this case, it is used to report to the CMU that the mobile station is switched on and ready for a call. After a location update of the mobile station, the signalling state *Synchronized* is reached.

Remote control

```
CONFigure:NETWork:SMODe:LOCupdate  ALWays
```

Default IMSI

The line *Default IMSI* defines an international mobile subscriber identity (IMSI) which is used to set up the call to the mobile. It consists of:

MCC	3-digit mobile country code
MNC	2-digit mobile network code
MSIN	10-digit mobile subscriber id. No.

The IMSI of the mobile phone must be known before the call can be established. If the IMSI is known and reported to the tester as *Default IMSI,* it doesn't have to be determined during the location update; the call procedure will be faster. For this purpose, the international mobile subscriber identity request must be switched off *(IMSI Request = Off).*

Otherwise, the *Default IMSI* is overwritten by the respective parameters of the mobile station as soon as these are requested and transferred. For this purpose, the international mobile subscriber identity request must be switched on *(IMSI Request = On).*

The default setting for the *Default IMSI* is MCC = 001, MNC = 01, MSIN = 1000000095 (Phase-2 mobile phones).

Remote control

```
CONFigure:NETWork:SMODe:IMSI:MCC  <MCC>
CONFigure:NETWork:SMODe:IMSI:MNC  <MNC>
CONFigure:NETWork:SMODe:IMSI:MSIN  <MSIN>
```

Power Change Mode

The line *Power Change Mode* controls the power change of the mobile station:

Slow	Slow power change, controlled via SACCH *(slow associated control channel),*
Fast	fast power change, controlled via FACCH *(fast associated control channel).*

Note: *The CMU does not check whether the new power has already been* *achieved at the end of the command (be careful with remote-control programs).*

Remote control `CONFigure:NETWork:SMODe:PCHange  FAST | SLOW`

Signalling Channel

The line *Signalling Channel* determines the channel to be used for the signalling:

SDCCH	Signalling via *stand-alone dedicated channel:* Call setup to traffic channel with an extra signalling channel (normal mode in the network), duration 4 s to 6 s
FACCH	Signalling via *fast associated control channel:* Fast call setup with signalling on traffic channel, duration 1 s to 2 s
NONE	Change to traffic channel without signalling

Remote control `CONFigure:NETWork:SMODe:SCHannel  SDCCh | FACCh | NONE`

Traffic

The line *Traffic* determines the speech coding and the transmission rate in the traffic channels:

Full Rate Version 1	Use of standard full-rate coding
Full Rate Version 2	Enhanced Full Rate,
Full Rate Version 3	
Half Rate Version 1	Half-rate coding
Half Rate Version 2	
Half Rate Version 3	
Data 2400	*Full-rate coding with fixed transmission rate in baud,*
Data 4800	
Data 9600	

Note: *A transmission mode can only be selected if the connected mobile station is equipped with the appropriate speech coder. If this is not the case, the CMU automatically sets the default speech coder (Full Rate Version 1).*

Remote control `CONFigure:NETWork:SMODe:TRAFfic  <Mode>`

Loop Command

The line *Loop Command* determines in which cases the loop command is sent to the mobile station. Closing of the loop causes the mobile station to send received bits back again. In the case of an open loop, the mobile station does not send back anything. Most but not all mobiles require a test SIM card to enter the loop-back mode.

Enable	If the test set sends a pseudo-random modulation (PSR2E9-1, PSR2E11-1, PSR2E15-1, PSR2E16-1, e.g. for Sensitivity measurement), the loop will automatically be closed. If no pseudo-random modulation is sent (ECHO, Loopback, Handset), the loop will automatically be open.
Disable	The CMU sends no loop command (not even with the bit-error-rate measurement).
Sensitivity	The CMU only sends the loop command with the bit-error-rate measurement.

A closed loop is a prerequisite for a receiver quality test (bit-error-rate measurement). However, it is useful even for transmitter measurements, since it permits to obtain a pseudo-random-modulated transmit signal from the mobile in an easy way. If the CMU transmits a pseudo-random modulation, the close loop command also causes a pseudo-random modulation of the signal returned by the mobile station.

Remote control `CONFigure:NETWork:SMODe:LCOMmand  ENABle | DISable | BER`

Starting Time

The line *Starting Time* determines a time interval after which the mobile station performs a new registration to the network after a channel, timeslot and fast power change (see *Power Change*).

The value 0 frames means that no starting time is used.

Remote control

```
CONFigure:NETWork:SMODe:STIMe  <Frames> | OFF
```

Requested Mobile Data

The field *Requested Mobile Data* determines which signalling parameters of the mobile station are requested and displayed:

IMSI Request	Request of the international mobile subscriber identity *(On)* or no request *(Off)*.
IMEI Request	Request of the international mobile station equipment identity *(On)* or no request *(Off)*.
Authentication Request	Switching the authentication request *On* or *Off.*
Handover Request	Request to determine whether the mobile station can hand over to another GSM radio network (e.g. GSM1800, GSM1900) *(On)* or not *(Off)*. Dual band handover is always possible.

The IMSI request can be switched off if the IMSI of the mobile phone is known and reported to the tester as *Default IMSI* (see above). This speeds up the call setup procedure.

Remote control

```
CONFigure:NETWork:REQuest:IMSI   ON | OFF
CONFigure:NETWork:REQuest:IMEI   ON | OFF
CONFigure:NETWork:REQuest:AUTHenticate   ON | OFF
CONFigure:NETWork:REQuest:HANDover   ON | OFF
```

Mobile Settings

The field *Mobile Settings* sets transmit parameters of the mobile station. These include

- the operating mode DTX (Discontinuous Transmission (DTX)),
- the output power of the mobile station (PCL Level).

Discontinuous Transmission (DTX)

The input *Discontinuous Transmission (DTX)* decides whether the mobile station may use the operating mode DTX *(On)* or not *(Off)*.

In the operating mode DTX *(discontinuous transmission mode)* the *voice activity detection* of the mobile station analyzes the language elements and the intervals and decides whether a transmission is required. As a result of this, only useful information is transferred; if nothing is spoken, the mobile station will not transmit anything. The DTX method permits to reduce radio interference, the power as well as the current consumption of the mobile stations.

Note: *Since the mobile station only transmits from time to time in DTX mode, the RF measurement can only sporadically be performed by the CMU. Therefore, DTX mode is not permissible in the default setting.*

Remote control

```
CONFigure:NETWork[:MS]:DTX  ON | OFF
[SENSe:]RREPorts:DTX?
```

PCL Level

The entry *PCL Level (power control level)* determines the power control level at which the mobile station sets up a call to the network and performs a location update (see below). The PCL levels defined in the GSM standard are listed in section *Limits for the Average Burst Power* on page 4.68.
If the powers specified are too high, the maximum possible power of the mobile station is used.

Important note:	*If very small powers are specified (underdrive), the mobile station, depending on its power class or GSM phase (phase 1 or 2, may actually transmit at a higher power so that the CMU may be overdriven.*
Example (GSM900):	*The minimum level of phase 2 mobile phones is 5 dBm (PCL 19), the minimum level of phase 1 is 13 dBm (PCL 15). If PCL 19 is set but a phase 1 mobile station is used, this mobile will transmit at 13 dBm (PCL 15).*

Remote control

```
CONFigure:NETWork[:MS]:POWer  <Level>
```

System Parameters

The field *System Parameters* determines system parameters for the radio link:

BS-AG-BLKS-RES	Number of data blocks (access grant channel) reserved for the AGCH access (basic services access grant blocks reserved) in the value range 0 to 7
BS-PA-MFRMS	Interval between two paging requests of the CMU in multiframes (basic service paging blocks available per multiframes) and in the value range 2 to 9
Paging Reorganisation	Mobile does not switch to the idle mode so it can be reached by all services (setting *Off).* In this state, the spurious emission of a mobile can be measured using a spectrum analyzer
Cell Access	Enabling (Not Barred) or disabling (Barred) a radio cell for mobile stations

Barring a radio cell means that the mobile station cannot synchronize to it and cannot perform a location update.

Remote control

```
CONFigure:NETWork:SYSTem:BSAGblkres  <Blocks>
CONFigure:NETWork:SYSTem:BSPamfrms  <Frames>
CONFigure:NETWork:SYSTem:BSPReorganis  ON | OFF
CONFigure:NETWork:SYSTem:CACCess  BARRed | NBARred
```

TimeOuts

The *TimeOuts* field determines timeouts after which an interrupted radio link or an unsuccessful call to the mobile station is aborted:

Radiolink Timeout Mobile	Time period after which a previously established but interrupted connection is dropped by the mobile station – number of missing SACCH blocks in the value range 4, 8, 12, ... 24, ... 64
Radiolink Timeout Testset	Time period after which an existing, but interrupted connection is aborted by the CMU – number of missing SACCH blocks in the value range 4, 5, 6, ... 24, ... 64. In the setting Off, the CMU does not abort the connection; this corresponds to an infinite timeout period
MTC Timeout	Maximum time period in seconds during which the phone is ringing in the case of call to mobile (mobile terminated call). If the handset is not picked up, the CMU returns to the *Synchronized* state. Values from 0 s to 10 s to 60 s can be set. In the Off setting, the number of the mobile station is dialed for an unlimited period of time; this corresponds to an infinite timeout

Timeouts are of particular importance in remote-control mode. For example, the remote-control program will not be able to continue if the keyboard of the mobile station is defective and the call can therefore not be answered by the mobile station.

Remote control

```
CONFigure:NETWork:TIMeout:RLINk[:MOBile]  <Time>
CONFigure:NETWork:TIMeout:RLINk:TESTset  <Time>
CONFigure:NETWork:TIMeout:MTC  <Time>
```

BA List

The *BA List* field configures the list of used channels in the neighbor cells *(BA list, BCCH allocation list)*. The BA list is of significance for selecting the radio cells of the mobile station. Up to 16 entries are possible in the list (i.e. 16 used channels in 16 neighbor cells).

00 ... 15	Current number of adjacent cell. It is possible to enter either no channel *(Off)* or one of the GSM channels.

Remote control

```
CONFigure:NETWork:BAList <Channel1>{, ... ,<Channel15>}
```

Advice of Charge

Advice of Charge comprises the settings for the advice of charge on the mobile station:

Enable	CMU sends (*On*) or does not send (*Off*) data for the advice of charge to the mobile station,
E1 ... E7	Formulas for calculation of the advice of charge according to GSM specification. Numerical input in the value range 0 to 8191.

Remote control

```
CONFigure:NETWork:AOCharge:ENABle  ON | OFF
CONFigure:NETWork:AOCharge <Value1>, ... ,<Value7>
```

RF Connectors (Connection Control – Connector/Ext. Att.)

The popup menu ↔*/Ext. Att.* selects the connectors for RF signals. This includes determination of

- RF input and RF output at the CMU *(RF Output, RF Input)*
- An external attenuation at the connectors *(Ext. Att. Output, Ext. Att. Input)*

The functions of this menu are described in the section *GSM900/1800/1900-MS Non Signalling* on page 4.43.

Reference Frequency (Connection Control – Synch.)

The popup menu *Synch.* determines the reference signal for synchronization. This includes

- The selection of internal or external reference frequency
- The output mode for the reference frequency *(F REF OUT 2)*

The functions of this menu are described in the section *GSM900/1800/1900-MS Non Signalling* on page 4.46.

Popup Menu Group Configuration

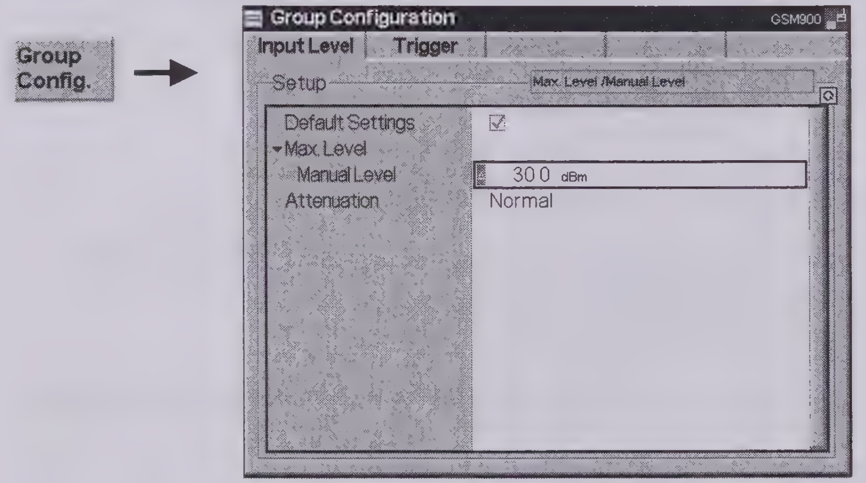
The popup menu *Group Configuration* contains four index cards which configure the measurements of the function group *GSM900/1800/1900-MS Signalling* globally, i.e. for all measurement menus. Most of the *Group Configuration* settings can be modified for an individual measurement using the softkeys and popup input fields provided in the graphical menus.

The popup menu *Group Configuration* is activated by pressing the softkey *Group Config.* at the top left of each measurement menu. Pressing of the associated hotkeys permits to change between the index cards.

Input Level (Group Configuration – Input Level)

The index card *Input Level* provides general settings for the measured input level:

- *Reference*
- *Max. Level*
- Gain or A*ttenuation*



Default Settings ☑
Max. Level
Manual Level 30.0 dBm
Attenuation Normal

Fig. 4-55 Group Configuration – Input Level

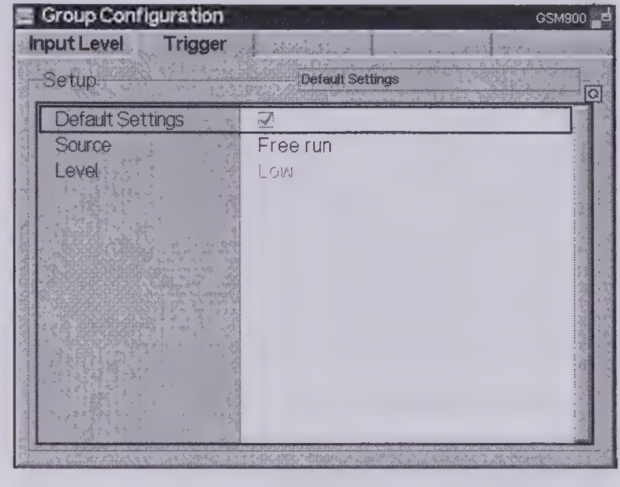
The functions of this menu are described in the section *GSM900/1800/1900-MS Non Signalling* on page 4.48. Note that here, in contrast to the *Non Signalling* mode, the input level can be set corresponding to the PCL of the connected mobile phone.

Reference	The *Reference* field sets the input attenuator and thus determines the maximum input level and the upper limit of the diagram in the graphical menu *Power vs Time*.	
	Manual	Manual input of maximum input level
	PCL	Input level corresponding to the power control level of the mobile station.
Remote control	`[SENSe:]LEVel:MODE MANual	PCL`	

Trigger (Group Configuration – Trigger)

The index card *Trigger* defines the trigger condition.

Group Config. →



Setup: Default Settings

Default Settings	☑
Source	Free run
Level	Low

Fig. 4-56 Group Configuration – Trigger

Trigger The *Trigger* field determines which type of time synchronization is used for the measurement:

Signalling	Triggering by the signalling unit of the instrument
Free Run	Triggering via TDMA timing of analyzed signal (synchronization information in the training sequence)
RF Power	Wide-band power trigger
IF Power	Narrow-band trigger

Triggering via an external signal is only possible in the *Non Signalling* mode.

Remote control `TRIGger[:SEQuence]:SOURce IMMediate | RFPower | IFPower`

Level The *Trigger Level* field determines the trigger threshold if the measurement is triggered by the *RF Power* or *IF Power*.
The trigger threshold is the level at which the trigger signal starts triggering. With *Free Run* measurements or *Signalling* the *Trigger Level* field is disabled.

Low	low trigger level equal to the reference level – 26 dB
Medium	medium trigger level equal to the reference level – 16 dB
High	high trigger level equal to the reference level – 6 dB

Remote control `TRIGger[:SEQuence]:THReshold LOW | MEDium | HIGH`

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5 Remote Control – Basics

This chapter gives a survey of the basic features and concepts of GSM remote control commands. Remote control can be described in terms analogous to the ones used in chapter 3 for the classification of menus and settings for the graphical user interface. In the following, we will particularly point out the similarities and differences between manual and remote control.

Structure and Order of Commands

Chapter 6 of this manual lists gives a description of all GSM remote control commands, including their parameters, default values and permissible ranges.

Function group and mode

The commands for the three function groups *GSM900-MS, GSM1800-MS* and *GSM1900-MS* are identical, however, the ranges or default values of their numerical parameters may not coincide. Numerical values are explicitly quoted for all three function groups.

Commands for the two modes *Signalling* and *Non Signalling* are listed separately although many of them have the same syntax.

Addressing

The function group and mode is specified via the secondary address of each command while the instrument name forms the primary address. This allows the same remote commands to be used in several function groups and modes:

```
ibwrt(h_GSM900MS_SIG, "INITiate:POWer")
ibwrt(h_GSM1800MS_SIG, "INITiate:POWer")
ibwrt(h_GSM900MS_NSIG, "INITiate:POWer")
```

provided that the variables `h_GSM900MS_SIG, etc.` have been appropriately defined, see program examples in chapter 7.

Order of commands

In chapter 6, the commands are arranged to form groups belonging to the same measurement or performing the same type of configurations. These groups are primarily identified by the second-level keyword (as in `POWer`) or by the combined second- and third-level keywords of each command (as in `SPECtrum:MODulation`). Their order is as follows:

- General configurations in the *Non Signalling* mode (`LEVel, TRIGger, RFANalyzer, RFGenerator, INPut, OUTPut, CORRection:LOSS, DM:CLOCk`)
- Measurement groups in the *Non Signalling* mode (`WPOWer, POWer, POWer:MPR, MODulation, SPECtrum:MODulation, SPECtrum:SWITching`)
- General configurations and signalling in the *Signalling* mode (`LEVel, TRIGger, SIGNalling, HANDover, BSSignal, NETWork, INPut, OUTPut, CORRection:LOSS, DM:CLOCk`)
- Measurement groups in the *Signalling* mode (`WPOWer, RREPorts, MSSInfo, POWer, POWer:PCL, POWer:MPR, MODulation, SPECtrum:MODulation, SPECtrum:SWITching, SENSitivity:SSHot, SENSitivity:CONTinuous`)

This structure differs from chapter 4 *(Functions and their Application)* where the measurements are presented first and special configurations are reported at the end of each signalling mode.

The menu of the graphical user interface corresponding to a group of commands is quoted at the beginning of each section. An alphabetical list of all commands is annexed to chapter 6.

SCPI Conformity In view of the particular requirements of GSM measurements not all commands could be taken from the SCPI standard. However, the syntax and structure of all commands is based on SCPI conventions. For a detailed description of the SCPI standard refer to chapter 5 of the operating manual for the CMU basic unit.

Remote Control All commands may be used for control of the CMU via GPIB interface.

Measurement Control

The commands in the measurement groups `WPOWer`, `POWer...`, `MODulation`, `SPECtrum:MODulation`, `SPECtrum:SWITching`, `SENSitivity:SSHot`, and `SENSitivity:CONTinuous` have an analogous structure and syntax. The measurements are controlled according to common concepts which are explained in detail in Chapter 5 of the CMU200 operating manual. The following sections show how the general concepts are applied to GSM-MS measurements.

Measurement Groups

The measurement groups are referred to as *measurement objects* (keyword <meas_obj>) in remote control. For GSM measurements, the following measurement objects are defined:

Table 5-1Measurement objects in the Signalling and Non Signalling Mode

Non Signalling	Signalling
`WPOWer` Wide-band peak power measurement of the input signal.	**`WPOWer`** Wide-band peak power measurement of the input signal.
`POWer` Burst power as a function of time including statistical evaluations and the results of the limit check.	**`POWer`** Burst power as a function of time including statistical evaluations and the results of the limit check.
	`POWer:PCL` Average burst power as a function of the PCL of the mobile phone on three different channels including limit check.
`POWer:MPR` Combined power and modulation measurement which should be used if scalar modulation results are needed while a power measurement is running.	**`POWer:MPR`** Combined power and modulation measurement which should be used if scalar modulation results are needed while a power measurement is running.
`MODulation` Phase error of the transmitted burst as a function of time. The frequency error, average and RMS phase error, statistical results and the results of the limit check can be evaluated in addition.	**`MODulation`** Phase error of the transmitted burst as a function of time. The frequency error, average and RMS phase error, statistical results and the results of the limit check can be evaluated in addition.
`SPECtrum:MODulation, SPECtrum:SWITching` Off-carrier power due to the modulation and the bursty nature of the RF signal (switching) including limit check.	**`SPECtrum:MODulation, SPECtrum:SWITching`** Off-carrier power due to the modulation and the bursty nature of the RF signal (switching) including limit check.
–	**`SENSitivity:SSHot<nr>, SENSitivity:CONTinuous`** Receiver quality measurements, i.e. measurement of the bit error rate and the residual bit error rate, with limit check.

The measurement groups are complemented by configuration settings for the inputs and outputs, input and output signals, trigger. In the signalling mode, the BS signal, network parameters and MS receiver reports can be configured or returned in addition. For an overview, see the list of remote control commands at the end of chapter 6.

Measurement Statistics

The *repetition mode* defines how many evaluation periods are measured if the measurement is not stopped explicitly (measurement control commands `STOP...`, `ABORT...`) or by a limit failure. With remote control the three repetition modes *Single Shot, Continuous* and *Counting* are available (*Counting* is not available in manual control, see chapter 3).

In `POWer` or `MODulation` measurements, different traces corresponding to the result in the current period, the maximum, minimum, or average evaluated over a set of periods are determined within one measurement. The four results can be queried independently.

Table 5-2 Repetition mode in remote control

Setting	**Description**	**Command**
Statistic Count	Integer number of evaluation periods forming one statistics cycle. An evaluation period is equal to a burst length (`POWer | MODulation | SPECtrum`) or a frame (`SENSitivity` measurements). The statistic count is set together with the measured quantity.	CONFigure:<meas_obj>:CONTrol SCALar | ARRay, **1 ... 1000 | NONE** (<meas_obj> = POWer | MODulation | SPECtrum:MODulation | SPECtrum:SWITching) CONFigure:SENSitivity:SSHot<nr>|CONTinuous:CONTrol <Mode>, **1 ... 50000 | NONE**
Repetition mode Single Shot	The measurement is stopped after one statistics cycle.	CONFigure:<meas_obj>:CONTrol:REPetition **SINGleshot**, <StopCondition> (<meas_obj> = WPOWer | POWer | MODulation | SPECtrum:MODulation, SPECtrum:SWITching) CONFigure:SENSitivity:**SSHot**<nr>:...
Continuous	The measurement is continued until stopped explicitly or by a limit failure. The statistical window for the calculation of average results is continuously shifted (continuous averaging).	CONFigure:<meas_obj>:CONTrol:REPetition **CONTinuous**, <StopCondition> (<meas_obj> = WPOWer | POWer | MODulation | SPECtrum:MODulation, SPECtrum:SWITching) CONFigure:SENSitivity:**CONTinuous**:...
Counting	Repeated single shot measurement with configured statistics cycles.	CONFigure:<meas_obj>:CONTrol:REPetition **1 ... 10000**, <StopCondition> (<meas_obj> = WPOWer | POWer | MODulation | SPECtrum:MODulation, SPECtrum:SWITching) This mode is not available for `SENSitivity` measurements. A counting measurement with 1 evaluation period is equivalent to a single shot measurement..
Traces	The four specifiers CURRent, MAXimum, MINimum, and AVERage allow the trace for the current evaluation period, the maximum, minimum or average of a set of evaluation periods to be retrieved. In general all four traces are evaluated during the measurement. They are selected via a keyword in the queries initiating a measurement and retrieving the results.	Measurement results: READ:ARRay:<meas_obj>[:RESult]:BURSt<disp>? .... where <meas_obj> = POWer | MODulation Burst matching: CALCULATE:POWER[:RESult]:BURSt:LIMit:MATChing<disp>? .... where <disp> = [:CURRent] | :AVERage | :MAXimum | MINimum

Specifying Limits

The following table gives an overview of the types of limits and possible results of the limit check.

Table 5-3 Limits and limit check

Type	Description	Command

Scalar limits	Limit values for a single (scalar) measured quantity. Depending on the measured quantity, either an upper limit or upper and lower limits can be defined.	`CONFigure:<meas_obj>:LIMit:<Spec.>`
		`[<LowerLimit>,]<UpperLimit>`
		<Spec.> denotes a keyword (an array of keywords) specifying the measured quantity.

Limit lines	For power ramp measurements a tolerance template consisting of up to 8 time ranges can be defined.	`CONFigure:<meas_obj>:LIMit:LINE:<Spec.>`
		`<Limit_line_param.>`
		<Spec.> denotes the two keywords specifying the upper or lower limit line in a time range and the burst type considered.
		<Limit_line_param.> contains the coordinates of the start and end points of the limit line plus an information whether the current range is valid or not.

Limit check	All scalar limits belonging to the same measurement group are read out together with the command on the right side.	`CALCulate:<meas_obj.>:LIMit:MATChing?`
	Possible results of the scalar limit check are listed on the right side. Further messages assessing, e.g., the power ramp or the result of the BER test in general, may be issued in particular cases (see detailed command description in chapter 6).	`NMAU` not matching, underflow `NMAL` not matching, overflow `INV` measured value invalid `OK` no limit failure

	The result of the limit check depends on the statistics settings (see section *Measurement Statistics* on page *5.4*).	`CALCULATE::<meas_obj>[:RESult]:`
		`BURSt:LIMit:MATChing<disp>?`
		`....`
		where `<disp> = [:CURRent] | :AVERage |`
		`:MAXimum | :MINimum`

Status Reporting System

A general description of SCPI status registers and of the status reporting system is given in chapter 5 of the CMU operating manual. This section is devoted to the particular features concerning GSM measurements.

The CMU offers 30 independent STATus:OPERation:SUM1|2:CMU<nr> sub-registers (<nr>=1 ... 15) which are implemented in hierarchical form. The bits of the 30 STATus:OPERation registers are set only after the registers are assigned to a function group and measurement mode.

In the CONDition part, the STATus:OPERation register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last readout. All fife parts of the registers can be read using one of the commands of the subsystem `STATus:OPERation:SUM1|2:CMU<nr>:...`

GSM mobile tests comprise the two signalling modes *Non Signalling* and *Signalling* for each of the three function groups *GSM900/1800/1900-MS* so that a total of 6 secondary addresses is used. In the three status registers for the *Non Signalling* mode the bit assignment is as follows:

Table 5-4 Meaning of the bits used in the STATus:OPERation:SUM1|2:CMU<nr> sub-registers assigned to *GSM900/1899/1900-MS Non Signalling*

Bit-No.	Meaning
6	**Reference Frequency not synchronized** This bit is set while the reference frequency is not synchronized.

In the three status registers for the *Signalling* mode the bit assignment is as follows:

Table 5-5 Meaning of the bits used in the STATus:OPERation:SUM1|2:CMU<nr> sub-registers assigned to *GSM900/1899/1900-MS Signalling*

Bit-No.	Meaning
0	**Call from Mobile** This bit is set while the CMU receives a call from the mobile under test.
1	**Release from Mobile** This bit is set while the connection to the mobile is being released.
2	**Synchronization Lost** This bit is set if the CMU had to leave the signalling state "Synchronized".
3	**Location Update** This bit is set while a location update is being performed.
6	**Reference Frequency not synchronized** This bit is set if the reference frequency is not synchronized yet.
7	**IMSI Detach** This bit is set if the CMU disconnected from the network.
8	**SMS received** This bit is set if a short message has been received but not yet read.

Special Terms and Notation

Below we list some particular features in the syntax of the GSM commands. The general description of the SCPI command syntax can be found in chapter 5 of the operating manual for the CMU basic unit, section *"Structure and Syntax of Device Messages"*.

Description of commands

The commands are arranged in tables; all of them are described along the same scheme. From top to bottom, the table rows contain the following entries:

1. Complete command syntax including the parameter list and a short description of the command,
2. List and description of the parameters with their default values, the units and unit rings.
3. Detailed description of the command, signalling state required for command execution, required firmware version.

Detailed lists of default values are annexed to the command description.

Order of commands

The commands are arranged according to their function. The general purpose of a command is described by the keyword in the second level or in the second/third level combined. Lower-level keywords define the command in more detail. This means that commands with the same second-level, third-level etc. keywords are generally grouped together in the same sections.

Example: `CONFigure:POWer:CONTrol:GRID <Enable>`

Commands with the keyword *POWer* in the second level belong to the power measurement. The keywords in the third and fourth level indicate that the command controls whether a grid is displayed in the power versus time diagram.

Measurement object

The term *measurement object* denotes a group of remote control commands belonging to the same group of measured quantities. E.g., all commands concerning the measurement of the signal power form a common measurement object.

A pseudo measurement object concerns quantities which do not actually have to be measured because they are automatically obtained during the signalling process (e.g. the receiver parameters reported by the mobile phone).

Combined measurements

To limit the number of remote control commands and their parameters, scalar results are always measured together and output in lists. Arrays (e.g. the traces for `POWer` and `MODulation` measurements) are output as lists of values separated by commas; it is possible to retrieve either the whole list (see commands `READ:ARRay...` etc.) or the values located in a number of subranges that are part of the total measurement range (see commands `READ:SUBarrays...;` the subarrays are defined via `CONFigure:SUBarrays...`).

Parameters

Many commands are supplemented by a parameter or a list of parameters. Parameters either provide alternative options (setting a or setting b or setting c ..., see special character "|"), or they form a list separated by commas (setting x,y).

<Par_Name>

Alternative settings are described by a common name (literal) written in angle brackets (<>). This literal serves as a description of the parameters only; in an application program it must be replaced by one of the settings given in the detailed parameter description.

Example: `CONFigure:POWer:CONTrol <Mode>,<Statistics>`

with
```
<Mode>       = SCALar | ARRay
<Statistics> = 1 ... 10000 | NONE
```

possible command syntax: `CONF:POW:CONT SCAL,NONE`

NAN A query will return NAN (not a number) if no result could be obtained (yet), or if the result obtained is invalid. NAN is defined in the SCPI standard. This is why in general NAN is not explicitly quoted in the list of possible values for numeric parameters.

INV If a tolerance values which were not defined previously are queried, the response INV (invalid) is returned.

Upper / lower case Upper/lower case characters characterize the long and short form of the keywords in a command. The short form consists of all upper-case characters, the long form of all upper case plus all lower case characters. On the CMU, either the short form or the long form are allowed; mixed forms will generally not be recognized. Note that the instrument itself does not distinguish upper case and lower case characters.

Special characters

| A vertical stroke in the parameter list characterizes alternative parameter settings. Only one of the parameters separated by | must be selected.

Example: The following command has two alternative settings:

```
TRIGger:SEQuence:DEFault ON | OFF
```

[ ] *Key words* in square brackets can be omitted when composing the command header (see chapter 5 of the CMU manual, section "Structure of a Command"). The complete command must be recognized by the instrument for reasons of compatibility with the SCPI standard.

Parameters in square brackets are optional as well. They may be entered in the command or omitted.

{ } Braces or curly brackets enclose one or more parameters that may be included zero or more times.

<nr> This symbol denotes a numeric suffix, e.g. an enumeration index for input and output connectors.

Alphabetical list of commands

Command: The *Command* column of the table contains all remote control commands arranged according to their function (configurations or measurement objects). Within a section, the commands are listed by alphabetical order.

Parameters: The *Parameter* column lists the parameters of the commands.

Remarks: The *Remarks* column gives additional information about the commands which

- Have no query form *(no query)*
- Have only a query form *(query only)*
- Can be used both as setting commands and as queries (*with query*, this applies to all commands belonging to none of the two preceding categories)

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6 Remote Control – Commands

In the following, all remote-control commands for the function groups *GSM900/1800/1900-MS* will be presented in tabular form with their parameters and the permissible ranges of values. The structure of this chapter is analogous to that of the reference part for manual operation (chapter 4).

- The measurement modes *Non Signalling* and *Signalling* are presented separately.
- Within the measurement modes, first the general configuration and then the individual measurement groups (test items) are dealt with.

General notes on remote control in the function group *GSM900/1800/1900-MS* can be found in Chapter 5. An introduction to remote control according to SCPI standard and the status registers of the CMU is given in chapter 5 of the operating manual for the CMU basic instrument.

GSM Measurements without Signalling (Non Signalling)

In the *Non Signalling* mode, a GSM-specific RF signal can be generated and an RF signal with GSM characteristics analyzed. No signalling parameters are transferred.

Group Configuration

The remote-control commands in this section are used to configure the measurements in the function group *GSM900-MS Non Signalling* globally, i.e. for all subsequent measurements. They correspond to the settings in the popup menu of the softkey *Group Config.* located to the left of the headline of each main menu (see chapter 3).

Subsystem LEVel (Input Level)

The subsystem *LEVel* determines the input level for the currently used input. It corresponds to the index card *Input Level* in the popup menu *Group Configuration.*

[SENSe:]LEVel:MAXimum *<Level>*				Max. Level
<Level>	Description of parameters	Def. value	Def. unit	Unit ring
0 dBm to +47 dBm	Maximum input level for RF 1	0.0	dBm	Power
–14 dBm to 33 dBm	Maximum input level for RF 2			
–37 dBm to 0 dBm	Maximum input level for RF 4 IN			
Description of command			Status	FW vers.
This command defines the maximum expected input level. The permissible value range depends on the RF input used and the external attenuation set (see `[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]` command).			all	

[SENSe:]LEVel:ATTenuation *<Mode>*				Attenuation
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
NORMal | **LNOise |** **LDIStortion**	Mixer level in normal range Low noise (mixer level 10 dB higher than in normal setting) Low distortion (mixer level 10 dB lower than in normal setting)	NORMal	–	–
Description of command			Status	FW vers.
This command defines an attenuation or gain factor for the RF input signal.			all	

[SENSe:]LEVel:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.			all	

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* determines the trigger mode. It corresponds to the index card *Trigger* in the popup menu *Group Configuration*.

TRIGger[:SEQuence]:SOURce *<Source>*				Source
<Source>	Description of parameters	Def. value	Def. unit	Unit ring
IMMediate	The power measurement is triggered by the TDMA timing.	IMM	–	–
RFPower	The power measurement is triggered by the incoming RF power (rising edge).			
IFPower	The power measurement is triggered by the IF power (rising edge).			
EXTern	External trigger signal at socket AUX3.			
Description of command			Status	FW vers.
This command determines the trigger condition. The setting *POWer* assumes bursted signals.			all	

TRIGger[:SEQuence]:THReshold *<Threshold>*				Level
<Threshold>	Parameter description	Def. value	Default unit	Unit ring
LOW | **MEDium** | **HIGH**	Low trigger threshold (reference level - 26 dB) Medium trigger threshold (reference level - 16 dB) High trigger threshold (Reference level - 6 dB))	MED	–	–
Command description			Status	FW vers.
This command sets the trigger level, i.e. the signal level at which the measurement is triggered (see `TRIG:SEQ:SOUR`). The command is enabled for trigger source `RFPower` and `IFPower` only.			all	≥ V 1.15

TRIGger[:SEQuence]:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.			all	

Connection Control

The remote-control commands presented in this section determine the signals analyzed and generated by the CMU, the inputs and outputs used to this end as well as the reference frequency. They correspond to the settings in the popup menu of the softkey *Connect. Control*, located to the right of the headline of each main menu.

Subsystem RFANalyzer (Analyzed Input Signals)

The subsystem *RFANalyzer* defines the signals received and analyzed by the CMU. It corresponds to the panel *Analyzer Settings* in the index card *Signal* in the popup menu *Connect. Control*.

[SENSe:]RFANalyzer:CHANnel *<Number>*				RF Channel
<Number>	Description of parameters	Def. value	Def. unit	Unit ring
0.2 MHz to 2700 MHz (see also data sheet)	Input frequency	903 (GSM900) 1750 (GSM 1800) 1880 (GSM 1900)	MHz MHz MHz	
Description of command			Status	FW vers.
This command defines the frequency of the RF signal analyzed. As an alternative to frequencies, the corresponding GSM channels (with the character string CH annexed to the channel number) can be entered (0CH to 124CH or 955CH to 1023CH for GSM900, 512CH to 885CH for GSM1800, 512CH to 810CH for GSM1900, see GSM channel tables in chapter 4). The assignment of channel numbers and frequencies meets the GSM specification for the uplink (signal direction from mobile to CMU). The query always returns frequencies.			all	

[SENSe:]RFANalyzer:FREQuency:OFFSet *<FreqOffset>*				Frequency Offset
<FreqOffset>	Description of parameters	Def. value	Def. unit	Unit ring
–10 kHz to +10 kHz	Offset for channel frequency	0	kHz	
Description of command			Status	FW vers.
This command defines an offset shifting the channel frequency set with the command `[SENSe:]RFANalyzer:CHANnel <Number>`. The offset frequency must be in multiples of 1 Hz.			all	1.20

[SENSe:]RFANalyzer:TSEQuence *<TrainingSequence>*				Training Sequence
<TrainingSequence>	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **GSM0 to GSM7 |** **DUMMy**	No training sequence GSM-specific training sequence GSM dummy bursrt	OFF	–	–
Description of command			Status	FW vers.
This command determines the training sequence of the signal analyzed by the CMU. If no training sequence is determined *(OFF)*, the CMU will measure all signals.			all	≥1.15

Generator Object "RFGenerator" – Generator control

The subsystem *RFGenerator* controls the internal RF generator. It corresponds to the softkey *RF Generator* in the index card *Signal* in the popup menu *Connect. Control* and the measurement menu *Analyzer/Generator*.

INITiate:RFGenerator **ABORt:RFGenerator**	Start RF generator, reserve resources Switch off RF generator, release resources	*RUN* *OFF*
Description of command	Status	FW vers.
These commands do not exist as queries. They start and stop the RF generator, setting it to the status indicated in the top right column.	all	≥1.15

FETCh:RFGenerator:STATus?				Generator Status
Returned values	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **RUN |** **ERR**	Generator switched off (`ABORt` or `*RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the current generator status.			all	≥1.15

Generator Level – Subsystem RFGenerator:LEVel

The subsystem *RFGenerator:LEVel* determines the level of the generated RF signals. It corresponds to the input field *RF Level* of the panel *RF Generator* in the index card *Signal* in the popup menu *Connect. Control*.

SOURce:RFGenerator:LEVel:UTIMeslot <*Level*>				RF Level used
<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–137 dBm ...–27 dBm **–137 dBm ...–10 dBm** **–90 dBm ...+13 dBm**	RF1 level in used timeslot RF2 level in used timeslot RF 3 OUT level in used timeslot	-27	dBm	Power level
Description of command			Status	FW vers.
This command determines the RF generator level in the used timeslot. The permissible value range depends on the used RF output of the CMU and the external attenuation set (see `[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]` command).			all	≥1.15

SOURce:RFGenerator:LEVel:UNTimeslot <*Level*>				RF Level unused
<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–110 dB to 0 dB **–110 dB to 17 dB** **–63 dB to 40 dB**	Level in unused timeslots, RF 1 Level in unused timeslots, RF 2 Level in unused timeslots, RF 3 OUT	–80	dB	Ratio
Description of command			Status	FW vers.
This command determines the RF generator level in the unused timeslots relative to the level in the used timeslot.			all	≥1.15
The absolute level in the unused timeslots, i.e. the sum of numerical values set under *UTIMeslot* and *UNTimeslot* must also lie within the permissible range for the RF output. This condition further restricts the permissible maximum level for the unused timeslots.				

RF Generator Frequency – Subsystem RFGenerator:FREQuency

The subsystem *RFGenerator:FREQuency* determines the frequency of the generated RF signals. It corresponds to the softkeys *RF Channel* and *Freq. Offset* of the panel *RF Generator* in the index card *Signal* in the popup menu *Connect. Control*.

SOURce:RFGenerator:FM:DEViation <*FrequencyOffset*>				Frequency Offset
<FrequencyOffset>>	Description of parameters	Def. value	Def. unit	Unit ring
–10.0 kHz to +10.0 kHz	Frequency offset	0	kHz	Freq.
Description of command			Status	FW vers.
This command determines a frequency offset for the CMU signals in the selected RF channel (with respect to the frequency specified in the GSM standard).			all	≥1.15

SOURce:RFGenerator:FREQuency:CHANnel <*Number*>				RF Channel
<Number>	Description of parameters	Def. value	Def. unit	Unit ring
0.2 MHz to 2700 MHz (see also data sheet)	Input frequency	948 (GSM900) 1845 (GSM 1800) 1960 (GSM 1900)	MHz MHz MHz	
Description of command			Status	FW vers.
This command defines the frequency of the RF signal generated. As an alternative to frequencies, the corresponding GSM channels (with the character string CH annexed to the channel number) can be entered (0CH to 124CH or 955CH to 1023CH for GSM900, 512CH to 885CH for GSM1800, 512CH to 810CH for GSM1900, see GSM channel tables in chapter 4). The assignment of channel numbers and frequencies meets the GSM specification for the downlink (signal direction from mobile to CMU). The query always returns frequencies.			all	

Subsystem RFGenerator:MODulation

The subsystem *RFGenerator:MODulation* determines an information which is modulated on the RF signal generated by the CMU and the signal shape. It corresponds to the panel *Generator Modulation* in the index card *Signal* in the popup menu *Connect. Control*.

CONFigure:RFGenerator:MODulation:BIT:SELection <*Selection*>				Bit Modulation
<Selection>	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **PRBS |** **DUMMybursts**	No modulation sequence Pseudo-random bit sequence GSM dummy bursts	OFF	–	–
Description of command			Status	FW vers.
The command selects a bit sequence used to modulate the signal generated by the CMU.			all	≥1.15

CONFigure:RFGenerator:MODulation:TSEQuence:SELection *<SELection>* Training Sequence

<Selection>	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **GSM0 to GSM7 |** **DUMMy**	No training sequence GSM standard training sequences no. 0 to 7 GSM dummy burst	GSM0	–	–
Description of command			Status	FW vers.
The command selects a training sequence used to modulate the signal generated by the CMU.			all	≥1.15

CONFigure:RFGenerator:MODulation:TRANsmission *<Transmission>* Transmission

<Transmission>	Description of parameters	Def. value	Def. unit	Unit ring
BURSt | **CONTinuous**	Bursted RF signal Continuous signal	BURSt	–	–
Description of command			Status	FW vers.
This command determines whether the the CMU generates a bursted or a contiunuous RF carrier signal.			all	≥1.15

Subsystem for Input and Output (External Attenuation at the Connectors)

The subsystem for input and output configures the input and output connectors. The subsystem corresponds to the index card *AF/RF* ⇨ in the popup menu *Connect. Control.*

INPut[:STATe] *<State>* RF Input

<State>	Description of parameters	Def. value	Def. unit	Unit ring
RF1 | **RF2 |** **RF4**	Connector RF 1 used as input Connector RF 2 used as input Connector RF 4 IN used as input	RF2	–	–
Description of command			Status	FW vers.
This command determines the connector to be used for incoming RF signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the very same measurement (see `OUTPut[:STATe]`). Only one input and one output may be active at a time, which is why the currently active one is automatically deactivated on switchover.			all	≥1.15

OUTPut[:STATe] *<State>* RF Output

<State>	Description of parameters	Def. value	Def. unit	Unit ring
RF1 | **RF2 |** **RF3**	Connector RF 1 used as output Connector RF 2 used as output Connector RF 3 OUT used as output	RF2	–	–
Description of command			Status	FW vers.
This command determines the connector to be used for outgoing RF signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the very same measurement. Only one input and one output may be active at a time, which is why the currently active one is automatically deactivated on switchover.			all	≥1.15

[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] *<Absorption>*
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] *<Absorption>* Ext. Att. Input

<Absorption>	Description of parameters	Def. value	Def. unit	Unit ring
–50 dB to +50 dB	Value for external attenuation at the input <nr>, where <nr> = 1,2,4	0.0	dB	–

Description of command	Status	FW vers.
This command assigns an external attenuation value to the inputs of the instrument *(RF 1, RF 2, RF 4 IN).*	all	≥1.15

[SENSe:]CORRection:LOSS:Output<nr>[:MAGNitude] *<Absorption>*
SOURce:CORRection:LOSS:Output<nr>[:MAGNitude] *<Absorption>* Ext. Att. Output

<Absorption>	Description of parameters	Def. value	Def. unit	Unit ring
–50 dB to +50 dB	Value for external attenuation at output <nr>, where <nr> = 1,2,3	0.0	dB	Ratio

Description of command	Status	FW vers.
This command assigns an external attenuation value to the inputs of the instrument *(RF 1, RF 2, RF 3 OUT).*	all	≥1.15

ROUTe:SPENcoder[:INPut] *<Source>* Speech Encoder

<Source>	Description of parameters	Def. value	Def. unit	Unit ring
HANDset |	Handset is used as source	HAND	–	–
GENerator |	AF generator is used as source			
AUX1	AUX1 connector is used as source			

Description of command	Status	FW vers.
This command determines the input source that feeds the CMU speech encoder (option CMU-B52).	all	V002 Audio

ROUTe:SPDecoder[:OUTPut] *<Destination>* Speech Decoder

<Destination>	Description of parameters	Def. value	Def. unit	Unit ring
HANDset |	Speech decoder output is routed to the handset	HAND	–	–
ANALyzer |	Speech decoder output is routed to the AF analyzer			
AUX2	Speech decoder output is routed to the AUX2 connector			

Description of command	Status	FW vers.
This command routes the CMU speech decoder output (option CMU-B52).	all	V002 Audio

Subsystem REFerence (Synchronization)

The subsystem *REFerence* sets a system clock specific to the network. This frequency is set in the index card *Synch.* in the popup menu *Connect. Control.*

SOURce:DM:CLOCk:STATe *<Mode>* REF OUT 2 on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch on/off system clock	OFF	–	–

Description of command	Status	FW vers.
This commands switches the system clock specific to the network at the *REF OUT 2* connector on or off.	all	≥1.15

SOURce:DM:CLOCk:FREQuency <Frequency> REF OUT 2

<Frequency>	Description of parameters	Def. value	Def. unit	Unit ring
1.219 MHz to 39.000 MHz	Input value for the system clock	13.000	MHz	

Description of command	Status	FW vers.
This command determines the system clock frequency applied to *REF OUT 2.* The frequency entered is internally rounded to one of the following discrete values: 39.000 MHz, 19.500 MHz, 13.000 MHz, 9.750 MHz, 7.800 MHz, 6.500 MHz, 5.571 MHz, 4.875 MHz, 4.333 MHz, 3.900 MHz, 3.545 MHz, 3.250 MHz, 3.000 MHz, 2.786 MHz, 2.600 MHz, 2.438 MHz, 2.294 MHz, 2.166 MHz, 2.053 MHz, 1.950 MHz, 1.857 MHz, 1.773 MHz, 1.696 MHz, 1.625 MHz, 1.560 MHz, 1.500 MHz, 1.444 MHz, 1.393 MHz, 1.349 MHz, 1.300 MHz, 1.258 MHz, 1.219 MHz	all	≥1.15

Test Object SPOWer (Wide Band Power)

The subsystem *SPOWer* measures the power of the signal transmitted by the mobile phone. It corresponds to the softkey *Power* of the index card *Signal* in the menu group *Connect. Control*.

INITiate:SPOWer	Start new measurement	*RUN*
ABORt:SPOWer	Abort measurement and switch off	*OFF*
STOP:SPOWer	Stop measurement	*STOP*
CONTinue:SPOWer	Next measurement step (only *counting mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status given in the top right column.	all	V1.15

CONFigure:SPOWer:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting*, see chapter 5 of CMU200 operating manual).	all	≥1.17

FETCh:SPOWer:STATus? Measurement Status

Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 ... 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	–

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU200 operating manual).	all	≥1.15

CONFigure:SPOWer:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>* Test cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 ... 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Start measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	≥1.15

Measured Values – Subsystem SPOWer:[RESult]

READ[:SCALar]:SPOWer[:RESult]? Start single shot measurement and return results
FETCh[:SCALar]:SPOWer[:RESult]? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:SPOWer[:RESults]? Read out measurement results (synchronized)

Return	Description of parameters	Def. value	Def. unit	Unit ring
–30.0dBm to +30.0 dBm	Maximum burst power (not averaged)	NAN	dBm	
Description of command			Status	FW vers.
These commands are always queries. They start the measurement of the maximum burst power of the signals sent by the mobile *(peak burst power)* and output the result.			all	≥1.15

Test Object POWer

The subsystem *POWer* measures the MS output carrier power versus time. The subsystem corresponds to the measurement menu *Power vs. Time* and the associated popup menu *Power vs Time Configuration.*

Control of measurement – Subsystem Power

The subsystem *POWer* controls the power measurement.

INITiate:POWer[:NORMal][:GMSK]	Start new measurement		*RUN*
ABORt:POWer[:NORMal][:GMSK]	Abort running measurement and switch off		*OFF*
STOP:POWer[:NORMal][:GMSK]	Stop measurement after current stat. cycle		*STOP*
CONTinue:POWer[:NORMal][:GMSK]	Next measurement step (only *stepping mode*)		*RUN*
Description of command		Status	FW vers.
These commands do not exist as queries. They start and stop the power measurement, setting it to the status indicated in the top right column.		all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	–
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).			all	≥1.17

FETCh:POWer[:NORMal][:GMSK]:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	–
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	–
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	≥1.15

Subsystem POWer:CONTrol

The subsystem *POWer:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Statistics* tabs in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:CONTrol *<Mode>, <Statistics>*				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	–
Description of command			Status	FW-Vers.
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle. *Attention: The settings defined with this command are valid for the modulation measurement as well.*			all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	≥1.15

DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID *<Enable>*				Grid on/off
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on the grid lines Switch off the grid lines	ON	–	–
Description of command			Status	FW vers.
This command switches the grid lines in the test diagram on or off.			all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault		Default Settings		
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.			all	2.0

Test Configuration

The commands of the following subsystems determine the parameters of the signal power measurement. They correspond to the *Power Configuration* popup menu. For a detailed explanation of the power tolerance template defined in the GSM standard see chapter 4.

Subsystem POWer:LIMIt:LINE

The subsystem *POWer:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the power measurement. The subsystem corresponds to the index card *Limit Lines* in the popup menu *Power vs Time Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:NORMal]:ENABle *<Enable>*
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:NORMal] Upper Limit Line
Parameters for query:
<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>,
<StartAbsLevel>, <EndAbsLevel>, <StartVisibility>, <EndVisibility>
for setting:
<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>,
<StartAbsLevel>, <EndAbsLevel>, <Visibility>

Parameters	Value range	Description of parameters	Def. unit
<Enable>	ON | OFF	Definition section on/off	see below
<StartTime>,	-100 µs to +700 µs | OFF (approx. -20 Bit to +180 Bit),	Start point of time	
<EndTime>,	–100 µs to +700 µs | OFF,	End point of time	
<StartRelLevel>,	–100 dB to 10 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB to 10 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm to 30 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm to 30.0 dBm | OFF,	End point of level (absolute)	
<Visibility>	ON | OFF	Range of limit lines on/off	
<StartVisib.>			
<EndVisib>			

Description of command	Status	FW vers.
These commands activate and define upper limit lines for normal bursts. The limit lines are defined area by area; the suffix <nr> numbers the various areas in the burst diagram (see chapter 4).	all	≥1.15

8 areas are defined in the default setting, another 8 areas can be activated if required. The default settings are given in the table below:

	for Enable	forTable						
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	–38.0 µs	–28.0 µs	–59.0 dB	–59.0 dB	–54.0 dBm	–54.0 dBm	ON
2	ON	–28.0 µs	–18.0 µs	–30.0 dB	–30.0 dB	–17.0 dBm	–17.0 dBm	ON
3	ON	–18.0 µs	–10.0 µs	–6.0 dB	–6.0 dB	OFF	OFF	ON
4	ON	–10.0 µs	0.0 µs	+4.0 dB	+4.0 dB	OFF	OFF	ON
5	ON	0.0 µs	552.8 µs	+1.0 dB	+1.0 dB	OFF	OFF	ON
6	ON	552.8 µs	560.8 µs	–6.0 dB	–6.0 dB	OFF	OFF	ON
7	ON	560.8 µs	570.8 µs	–30.0 dB	–30.0 dB	–17.0 dBm	–17.0 dBm	ON
8	ON	570.8 µs	600.0 µs	–59.0 dB	–59.0 dB	–54.0 dBm	–54.0 dBm	ON
9	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

The setting *Visibility = Off* implies that the corresponding range, including the limit check, is switched off. *Enable = Off* switches off the entire limit check.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:NORMal]:ENABle ***<Enable>***
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:NORMal] Lower Limit Line

Parameters for query:
<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>,
<StartAbsLevel>, <EndAbsLevel>, <StartVisibility>, <EndVisibility>
for setting:
<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>,
<StartAbsLevel>, <EndAbsLevel>, <Visibility>

Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Definition section on/off	See below
<StartTime>,	-100 µs to +700 µs | OFF (-20 Bit to +180 Bit),	Start point of time	
<EndTime>,	–100 µs to +700 µs | OFF,	End point of time	
<StartRelLevel>,	–100 dB to 10 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB to 10 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm to 30 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm to 30.0 dBm | OFF,	End point of level (absolute)	
<Visibility>	ON | OFF	Range of limit lines on/off	
<StartVisib.>			
<EndVisib>			

Description of command	Status	FW vers.
These commands activate and define lower limit lines for normal bursts. The limit lines are defined area by area; the suffix <nr> numbers the various areas in the burst diagram (see chapter 4).	all	≥1.15

Only 1 area is defined in the default setting, another 15 areas can be activated if required. The default settings are shown in the table below:

	forEnable	forTable						
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	0.0 µs	0.0 µs	–100.0 dB	–1.0 dB	OFF	OFF	ON
2	ON	0.0 µs	542.8 µs	–1.0 dB	–1.0 dB	OFF	OFF	ON
3	ON	542.8 µs	542.8 µs	–1.0 dB	–100.0 dB	OFF	OFF	ON
4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>:MODE ***<Mode>***
Upper Limit Line on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on upper limit lines Switch off upper limit lines	ON	–	

Description of command	Status	FW vers.
This command switches the upper limit lines in area no <nr> on or off.	all	

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>:MODE *<Mode>*				Lower Limit Line on/off
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on lower limit lines Switch off lower limit lines	ON	–	
Description of command			Status	FW vers.
This command switches the lower limit lines in area no <nr> on or off.			all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	the parameters are set to their default values the parameters differ from the default values (partially or totally)	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.			all	≥1.15

Subsystem POWer:TIME

The subsystem *POWer:TIME* contains the command for shifting the burst relative to the time axis (and thus the tolerance template). The subsystem corresponds to the popup window *Time - Mode* in the graphical measurement menu *Power.*

CONFigure:POWer[:NORMal][:GMSK]:TIME:MODE *<Mode>*				Mode
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
GSM | **OFFSet**	Positioning conforming to GSM, Fixed ½-bit time offset	GSM	–	
Description of command			Status	FW vers.
This command defines a time interval by which the burst is shifted relative to the time axis and the tolerance template.			all	≥1.15

Subsystem SUBarrays:POWer

The subsystem *SUBarrays:POWer* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK] <Mode>,<Range>{,<Range>}

Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL |	Return all measurement values	ALL	–	–
ARIThmetical |	Return arithm. mean value in every range			
MINimum |	Return minimum value in every range			
MAXimum,	Return maximum value in every range			

<Range>	Description of parameters	Def. value	Def. unit	Unit ring
–100 µs to 700 µs,	Start time in current range	NAN	µs	
0 to 668	Number of samples in current range	NAN	–	

Description of command	Status	FW vers.
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. The subranges may overlap but must be within the total range of the *power vs time* measurement. If the combination of start time and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.	all	2.0

Measured Values – Subsystem POWer[:RESult]

The subsystem *POWer[:RESULT]* determines and outputs the results of the signal power measurement. They correspond to the graphical measurement menu *Power* with its various display elements.

READ[:SCALar]:POWer[:NORMal][:GMSK][:RESult]? Scalar results:
Start single shot measurement and return results

FETCh[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?
Read out measurement results (unsynchronized)

SAMPle[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?
Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
PeakBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
BurstMatching	MATC | NMAT | INV | NTSC | OUT	INV	–	
AvgBurstPwAvg	–100.0 dBm to +20.0 dBm	NAN	dBm	

Description of command	Status	FW vers.
These commands are always queries. They start a measurement and output all scalar measurement results (see chapter 5). These are: *Average power of current burst* *Peak power of current burst* *Burst out of tolerance* *Average power of averaged trace* The calculation of results in an *average* or *peak* measurement is described in chapter 3 (cf. *display modes*).The following messages may be output for the value *BurstMatching*: MATC *matching* NMAT *not matching* INV *invalid* NTSC *no training sequence code* OUT *out of range*	all	≥1.15

CALCulate[:SCALar]:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing? Limit Matching

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching,	MATC | NMAT | INV | NTSC | OUT	INV	–	
AvgBurstPwAvg	NMAU | NMAL | INV | OK	INV	–	

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see command above) have been exceeded.		≥1.15

The following messages may be output for the values A*vgBurstPower and PeakBurstPower*:

NMAU	Tolerance value underflow	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	Tolerance value matched	

The following messages may be output for the value *BurstMatching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of range*

READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]? Burst Power
READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Start single shot measurement and return results *RUN*
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB... + 20.0 dB,	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit. The calculation of results in the modes *current, average, maximum* and *minimum* is explained in chapter 3 (cf. *display modes*).	all	≥1.15

READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]? Subarray Results
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Start single shot measurement and return results *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB... + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:POWer` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MINimum?
Burst Matching

Returned values	Value range	Def. value	Def. unit	Unit ring
<Matching>	MATC | NMAT | INV | NTSC | OUT	INV	–	–

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible tolerances for the burst power (see preceding command) have been exceeded. The following messages may be output for the measured value *Matching*: MATC *matching* NMAT *not matching* INV *invalid* NTSC *no training sequence code* OUT *out of tolerance*	all	≥1.15

CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MINimum?

Range Violation

Returned value	Description of parameters	Def. value	Def. unit	Unit ring
32 bit field,	Indicator for upper limit matching in area 1 to 16	NAN	–	–
32 bit field	Indicator for lower limit matching in area 1 to 16	NAN	–	–

Description of command	Status	FW vers.
This command is always a query. Any set bit of the two returned fields indicates the violation of the corresponding section of the limit lines.	all	1.20

Test Object POWer:MPR

The subsystem *POWer:MPR* combines the *POWer* and *MODulation* systems, i.e. it measures the signal power vs. time and the scalar modulation parameters simultaneously. The subsystem contains all commands for measurement control and for the output of measurement results; configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

The *POWER:MPR* has no equivalent in manual control where the power and modulation measurement results are displayed separately.

Control of measurement – Subsystem Power:MPR

The subsystem *POWer:MPR* controls the combined power and modulation measurement.

INITiate:POWer[:NORMal][:GMSK]:MPR	Start new measurement	*RUN*
ABORt:POWer[:NORMal][:GMSK]:MPR	Abort running measurement and switch off	*OFF*
STOP:POWer[:NORMal][:GMSK]:MPR	Stop measurement after current stat. cycle	*STOP*
CONTinue:POWer[:NORMal][:GMSK]:MPR	Next meas. step (only *stepping mode*)	*RUN*
Description of command	Status	FW vers.
These commands do not exist as queries. They start and stop the combined power and modulation measurement, setting it to the status indicated in the top right column.	all	2.0

CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).			all	2.0

FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle	NONE	–	–
NONE,	No counting mode set			
1 to 1000 |	Counter for current evaluation period within a cycle	NONE	–	–
NONE	Statistic count set to off			
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	2.0

Subsystem POWer:MPR:CONTrol

The subsystem *POWer:MPR:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement.

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol *<Mode>, <Statistics>*				
				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	–
Description of command			Status	FW-Vers.
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.			all	2.0

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				
				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	2.0

Test Configuration

The commands of the following subsystems configure the combined power and modulation measurement. Note that configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

Subsystem SUBarrays:POWer:MPR

The subsystem *SUBarrays:POWer:MPR* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR <Mode>,<Range>{,<Range>}

Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>	Description of parameters	Def. value	Def. unit	Unit ring
–100 µs to 700 µs,	Start time in current range	NAN	µs	
0 to 668	Number of samples in current range	NAN	–	
Description of command			Status	FW vers.
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:MPR` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. The subranges may overlap but must be within the total range of the *power vs time* measurement. If the combination of start time and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.			all	2.0

Measured Values – Subsystem POWer:MPR[:RESult]

The subsystem *POWer:MPR[:RESULT]* determines and outputs the results of the combined power and modulation measurement.

READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]? Scalar Results:
Start single shot measurement and return results
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?
Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?
Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
PeakBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
BurstMatching,	MATC | NMAT | INV | NTSC | OUT	INV	–	
PhErrPeakCurrent,	–100.0 °to +100.0 °	NAN	deg	
PhErrPeakAverage,	–100.0 °to +100.0 °	NAN	deg	
PhErrPeakMaxMin,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSCurrent,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSAverage,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSMaxMin,	–100.0 °to +100.0 °	NAN	deg	
FreqErrCurrent,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrAverage,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrMaxMin,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
AvgBurstPwAvg	–100.0 dBm to +20.0 dBm	NAN	dBm	

Description of command	Status	FW vers.
These commands are always queries. They start a combined power vs. time and modulation measurement and output all scalar measurement results. For detailed information refer to the description of the analogous commands in the POWer and MODulation systems.	all	2.0

READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]? Traces
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Start single shot measurement and return results *RUN*
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB... + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit. The calculation of *current, average, minimum* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]? Subarray Results
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Start measurement and wait for end *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB... + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

CALCulate:POWer[:NORMal][:GMSK]:MPR[:RESult]:LIMit:MATChing? Tolerance Error

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching,	MATC | NMAT | INV | NTSC | OUT	INV	–	
PhErrPeakCurrent,	For all measured values: NMAU |NMAL | INV | OK	INV	–	
PhErrPeakAverage,		INV	–	
PhErrPeakMaxMin,		INV	–	
PhErrRMSCurrent,		INV	–	
PhErrRMSAverage,		INV	–	
PhErrRMSMaxMin,		INV	–	
FreqErrCurrent,		INV	–	
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPwAvg		INV	–	

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar resultss (see command above) in the *power vs time* and the *modulation* measurement have been exceeded.	all	2.0

The following messages may be output for the values A*vgBurstPower* and *PeakBurstPower* and for all results of the modulation measurement:

NMAU	Tolerance value underflow	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	Tolerance value matched	

The following messages may be output for the value *BurstMatching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of range*

Test Object MODulation

The subsystem *MODulation* measures the modulation parameters, i.e. the frequency and phase errors of the measured bursts. The subsystem corresponds to the measurement menu *Phase/Frequency* and the associated popup menu *Phase/Freq. Error Config.*

Control of Measurement – Subsystem MODulation

The subsystem *MODulation* controls the modulation measurement. It corresponds to the softkey *Phase/Freq.* in the measurement menu *Phase/Frequency*.

INITiate:MODulation	Start new measurement		*RUN*
ABORt:MODulation	Abort running measurement and switch off		*OFF*
STOP:MODulation	Stop measurement after current stat. cycle		*STOP*
CONTinue:MODulation	Next measurement step (only *stepping mode*)		*RUN*
Description of command		Status	FW vers.
These commands do not exist as queries. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		all	≥1.15

CONFigure:MODulation:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).			all	≥1.15

FETCh:MODulation:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE,	No counting mode set	NONE	–	–
1 to 1000 |	Counter for current evaluation period within a cycle			
NONE	Statistic count set to off	NONE	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	≥1.15

Subsystem MODulation:CONTrol

The subsystem *MODulation:CONTrol* configures the modulation measurement. It corresponds to the index cards *Control* and *Statistics* in the popup menu *Phase/Freq. Error Config.*

CONFigure:MODulation:CONTrol *<Mode>, <Statistics>* Scope of Measurement

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	ARRay	–	–

<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	–

Description of command	Status	FW vers.
This command selects the type of measured values and determines the number of bursts forming one statistics cycle. **Attention:** *The settings defined with this command are valid for the power vs time measurement as well.*	all	≥1.15

CONFigure:MODulation:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>* Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–

<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–

<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–

Description of command	Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*	all	≥1.15

CONFigure:MODulation:CONTrol:DEFault *<Mode>* Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	–

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*	all	

Tolerance values – Subsystem MODulation:LIMit

The subsystem *MODulation:LIMit* defines tolerance values for the modulation measurement. The subsystem corresponds to the index card *Limits* in the popup menu *Modulation.*

CONFigure:MODulation:LIMit:UPPer[:CURRent] Upper Phase/Freq. Errors
<PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>

Parameter	Description of parameters	Def. value	Def. unit	Unit ring
0.0 deg ... +50.0 deg	PhaseErrorPeak	+20.0	deg	Angle
0.0 deg ... +50.0 deg	PhaseErrorRMS	+5.0	deg	
0.0 deg ... +1000 Hz	FrequencyError	+90	Hz	

Description of command	Status	FW vers.
This command defines upper limits for the peak and RMS phase error as well as for the frequency error in the current or maximum trace. The default frequency error is 90 Hz for GSM900, 180 Hz for GSM1800/1900.	all	≥1.15

CONFigure:MODulation:LIMit:UPPer:MODE *<Mode>* Upper Limit Check on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Upper limit check on	ON	–	–
OFF	Upper limit check off			

Description of command	Status	FW vers.
This command switches on or off the tolerance check with respect to the upper limit lines (current and average).	all	≥2.0

CONFigure:MODulation:LIMit:LOWer[:CURRent] Lower Phase/Freq. Errors
<PhaseErrorPeak>,<FrequencyError>

Parameter	Description of parameters	Def. value	Def. unit	Unit ring
–50.0 deg... 0.0 deg	PhaseErrorPeak	–20.0	deg	
–1000 Hz...0 Hz	FrequencyError	–90	Hz	

Description of command	Status	FW vers.
This command defines lower limits for the peak phase error and for the frequency error in the current or maximum trace (the RMS phase error is positive by definition). The default frequency error is –90 Hz for GSM900, –180 Hz for GSM1800/1900.	all	≥1.15

CONFigure:MODulation:LIMit:LOWer:MODE <Mode> Lower Limit Check on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Lower limit check on	ON	–	–
OFF	Lower limit check off			

Description of command	Status	FW vers.
This command switches on or off the tolerance check with respect to the lower limit lines (current and average).	all	≥2.0

CONFigure:MODulation:LIMit:UPPer:AVERage Upper Average Limits
<PhaseErrorPeak>, <PhaseErrorRMS>,<FrequencyError>

Parameter	Description of parameters	Def. value	Def. unit	Unit ring
0.0 to +50.0 deg	PhaseErrorPeak	+20.0	deg	
0.0 to +50.0 deg	PhaseErrorRMS	+5.0	deg	
0.0 to +1000 Hz	FrequencyError	+90	Hz	

Description of command	Status	FW vers.
This command defines upper limits for the peak and RMS phase error as well as for the frequency error in the average trace. The default frequency error is 90 Hz for GSM900, 180 Hz for GSM1800/1900.	all	≥1.15

CONFigure:MODulation:LIMit:LOWer:AVERage Lower Average Limits
<PhaseErrorPeak>, <PhaseErrorRMS>,<FrequencyError>

Parameter	Description of parameters	Def. value	Def. unit	Unit ring
–50.0 deg...0.0 deg	PhaseErrorPeak	–20.0	deg	
–1000 Hz...0 Hz	FrequencyError	–90	Hz	

Description of command	Status	FW vers.
This command defines lower limits for the maximum phase error as well as for the frequency error in the average trace (the RMS phase error is positive by definition). The default frequency error is –90 Hz for GSM900, –180 Hz for GSM1800/1900.	all	≥1.15

CONFigure:MODulation:LIMit:DEFault *<Mode>* Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	The parameters are set to their default values	ON	–	–
OFF	Some or all parameters differ from the default values			

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	all	

Subsystem SUBarrays:MODulation

The subsystem *SUBarrays:MODulation* defines the measurement range and the type of output values.

<table>
<tr><td colspan="3">CONFigure:SUBarrays:MODulation <Mode>,<Range>{,<Range>}</td><td colspan="2">Definition of Subarrays</td></tr>
<tr><td><i><Mode></i></td><td>Description of parameters</td><td>Def. value</td><td>Def. unit</td><td>Unit ring</td></tr>
<tr><td>ALL |</td><td>Return all measurement values</td><td>ALL</td><td>–</td><td>–</td></tr>
<tr><td>ARIThmetical |</td><td>Return arithm. mean value in every range</td><td></td><td></td><td></td></tr>
<tr><td>MINimum |</td><td>Return minimum value in every range</td><td></td><td></td><td></td></tr>
<tr><td>MAXimum,</td><td>Return maximum value in every range</td><td></td><td></td><td></td></tr>
<tr><td><i><Range></i></td><td>Description of parameters</td><td>Def. value</td><td>Def. unit</td><td>Unit ring</td></tr>
<tr><td>–100 μs to 700 μs,</td><td>Start time in current range</td><td>NAN</td><td>μs</td><td></td></tr>
<tr><td>0 to 588</td><td>Number of samples in current range</td><td>NAN</td><td>–</td><td></td></tr>
<tr><td colspan="3">Description of command</td><td>Status</td><td>FW vers.</td></tr>
<tr><td colspan="3">This command configures the <code>READ:SUBarrays...</code>, <code>FETCh:SUBarrays...,</code>, and <code>SAMPle:SUBarrays:MODulation</code> commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit.
The subranges may overlap but must be within the total range of the <i>power vs time</i> measurement. If the combination of start time and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically.
By default, only one range corresponding to the total measurement range is used and all measurement values are returned.</td><td>all</td><td>2.0</td></tr>
</table>

Measured Values – Subsystem MODulation[:RESult]

The subsystem *MODulation[:RESULT]* measures and returns the burst power and compares it with the tolerance values. The subsystem corresponds to the various output elements in the graphical measurement menu *MODulation.*

READ[:SCALar]:MODulation[:RESult]?	Scalar Results: Start single shot measurement and return results
FETCh[:SCALar]:MODulation[:RESult]?	Read out meas. results (unsynchronized)
SAMPle[:SCALar]:MODulation[:RESult]?	Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
PhErrPeakCurrent,	–100.0 °to +100.0 °	NAN	deg	
PhErrPeakAverage,	–100.0 °to +100.0 °	NAN	deg	
PhErrPeakMaxMin,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSCurrent,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSAverage,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSMaxMin,	–100.0 °to +100.0 °	NAN	deg	
FreqErrCurrent,	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
FreqErrAverage,	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
FreqErrMaxMin,	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
AvgBurstPowerCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
BurstsOutOfTol	0.0 % to 100.0 %	NAN	%	

Description of command	Status	FW vers.
These commands are always queries. They start a measurement and output all scalar measurement results (see chapter 5). These are:	all	≥1.15

Peak phase error of current burst	*phase error peak current*
Peak phase error of average measurement	*phase error peak average*
Peak phase error of peak measurement	*phase error peak max./min.*
Rms phase error of current burst	*phase error RMS current*
Rms phase error of average measurement	*phase error RMS average*
Rms phase error of peak measurement	*phase error RMS max./min.*
Frequency error of current burst	*frequency error current*
Frequency error of average measurement	*frequency error average*
Frequency error of peak measurement	*frequency error max./min.*
Average burst power of current burst	*avg. burst power current*
Relative portion of faulty bursts	*bursts out of tolerance*

The calculation of results in an *average* or *peak* measurement is described in chapter 3 (cf. *calculation of statistical quantities*).

CALCulate:MODulation[:RESult]:LIMit:MATChing? Bursts out of Tolerance

Returned values	Value range	Def. value	Def. unit	Unit ring
PhErrPeakCurrent,	**For all measured values:**	INV	–	–
PhErrPeakAverage,		INV	–	
PhErrPeakMaxMin,		INV	–	
PhErrRMSCurrent,	**NMAU |NMAL | INV | OK**	INV	–	
PhErrRMSAverage,		INV	–	
PhErrRMSMaxMin,		INV	–	
FreqErrCurrent,				
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPowerCurr		INV	–	
		INV	–	

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible error limits for the scalar measured values (see above command) have been exceeded. The following messages may be output for all measured values:		≥1.15

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

READ:ARRay:MODulation[:RESult][:BURSt][:CURRent]? Phase Error in Burst
READ:ARRay:MODulation[:RESult][:BURSt]:AVERage?
READ:ARRay:MODulation[:RESult][:BURSt]:MMAX?
Start single shot measurement and return results *RUN*
FETCh:ARRay:MODulation[:RESult][:BURSt][:CURRent]?
FETCh:ARRay:MODulation[:RESult][:BURSt]:AVERage?
FETCh:ARRay:MODulation[:RESult][:BURSt]:MMAX?
Read measurement results (unsynchronized) *RUN*
SAMPle:ARRay:MODulation[:RESult][:BURSt][:CURRent]?
SAMPle:ARRay:MODulation[:RESult][:BURSt]:AVERage?
SAMPle:ARRay:MODulation[:RESult][:BURSt]:MMAX?
Read measurement results (synchronized) *RUN*

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	dB	
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They return the phase error of the burst vs. time in a fixed ¼-bit pattern. The number of measured values is 588, corresponding to a time range of 0 bit to 146 ¾ bit. The calculation of *current, average, and mmax* (Min./Max.) results is explained in chapter 3 (cf. *display mode*).	all	≥1.15

READ:SUBarrays:MODulation[:RESult][:BURSt][:CURRent]? **READ:SUBarrays:MODulation[:RESult][:BURSt]:AVERage?** **READ:SUBarrays:MODulation[:RESult][:BURSt]:MMAX?**				Subarray Results
	Start single shot measurement and return results			*RUN*
FETCh:SUBarrays:MODulation[:RESult][:BURSt][:CURRent]? **FETCh:SUBarrays:MODulation[:RESult][:BURSt]:AVERage?** **FETCh:SUBarrays:MODulation[:RESult][:BURSt]:MMAX?**				
	Read meas. results (unsynchronized)			*RUN*
SAMPle:SUBarrays:MODulation[:RESult][:BURSt][:CURRent]? **SAMPle:SUBarrays:MODulation[:RESult][:BURSt]:AVERage?** **SAMPle:SUBarrays:MODulation[:RESult][:BURSt]:MMAX?**				
	Read results (synchronized)			*RUN*
Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	xth value for burst power	NAN	dB	
Description of command			Status	FW vers.
These commands are always queries. They output the phase error versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:MODulation` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:MODulation` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).			all	2.0

Test Object SPECtrum due to MODulation

The subsystem *SPECtrum:MODulation* measures the off-carrier power due to the modulation of the GSM signal. The subsystem corresponds to the measurement menu *Spectrum* and the associated configuration popups.

Control of Measurement – Subsystem SPECtrum:MODulation

The subsystem *SPECtrum:MODulation* controls the spectrum measurement.

INITiate:SPECtrum:MODulation	Start new measurement	*RUN*
ABORt:SPECtrum:MODulation	Abort running measurement and switch off	*OFF*
STOP:SPECtrum:MODulation	Stop measurement after current stat. cycle	*STOP*
CONTinue:SPECtrum:MODulation	Next measurement step (only *stepping mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status indicated in the top right column.	all	V1.20

CONFigure:SPECtrum:MODulation:EREPorting <*Mode*> — Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).	all	V1.20

FETCh:SPECtrum:MODulation:STATus? — Measurement Status

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE,	No counting mode set	NONE	–	–
1 to 1000 |	Counter for current evaluation period within a cycle			
NONE	Statistic count set to off	NONE	–	–

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	all	V1.20

Subsystem SPECTrum:MODulation:CONTrol

The subsystem *SPECtrum:MODulation:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Statistics* tabs in the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:MODulation:CONTrol *<Mode>,<Statistics>* Scope of Measurement

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Only scalar measured values Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	200	–	–
Description of command			Status	FW vers.
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.			all	V1.20

CONFigure:SPECtrum:MODulation:CONTrol:REPetition *<Repetition>,<StopCondition>,<Stepmode>* Test cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	V1.20

DISPlay:SPECtrum:MODulation:CONTrol:GRID *<Enable>* Grid on/off

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	–
Description of command			Status	FW vers.
This command switches the grid lines in the test diagrams on or off.			all	V1.20

CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle <Enable>

Enable/Disable Measurement Points

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on measurement point <nr> Switch off measurement point <nr>	ON	–	–

Description of command	Status	FW vers.
This command switches the measurement at the individual frequency points no. 1 to 11 (numbered by the numeric suffix <nr>) on or off. Each number denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.1 MHz, <nr>=11 to ±1.8 MHz.	all	V1.20

CONFigure:SPECtrum:MODulation:CONTrol:DEFault *<Mode>*

Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem are set to default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.	all	2.0

Test Configuration

The commands of the following subsystems configure the spectrum due to modulation. They correspond to the *due to Modulation* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:MODulation:LIMit:LINE

The subsystem *SPECtrum:MODulation:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to modulation measurement The subsystem corresponds to the *due to Modulation* sections in the index card *Limit Lines* in the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>:ENABle <Enable>

CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr> Limits

<MinPwLevelRel>, <MaxPwLevelRel>, <AbsPwLevel>, <Enable>

Numeric Suffix	Value range	Description of parameters	Def. value
<nr>	1 to11	Measurement point (frequency) no.	
Parameters	**Value range**	**Description of parameters**	**Def. value**
<Enable>	ON | OFF	Defined section on/off	See below
<MinPwLevelRel>,	–99.9 dB to 99.9 dB	Limit for relative power below the interpolation range	See below
<MaxPwLevelRel>,	–99.9 dB to 99.9 dB	Limit for relative power above the interpolation range	See below
<AbsPwLevel>,	–99.9 dBm to 99.9 dBm	Alternative absolute power limit	
<Enable>	ON | OFF	Enable or disable limit check for frequency point <nr>	See below

Description of command	Status	FW vers.
These commands activate and define limit lines for the spectrum due to modulation measurement. Each number <nr> denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.1 MHz, <nr>=11 to ±1.8 MHz.	all	V1.20
The limits are defined at up to 11 fixed frequencies numbered by the numeric suffix <nr> and as a function of the MS output power level. Outside the interpolation range defined via `CONFigure:SPECtrum:MODulation:LIMit:LINE :REFPower[:UPPer]`, the fixed relative power limits *<MinPwLevelRel> and <MaxPwLevelRel>* apply. Inside this range, the limits are derived from these values by linear interpolation. As an alternative, an absolute power limit is set. For a more detailed explanation see chapter 4. To switch on or off the complete limit check please use the command `CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer]`		

Default values for GSM900:

Frequency	Min.P. Lev.rel.	Max.P. Lev.rel.	Level abs.
± 0.10 MHz	+0.5 dB	+ 0.5 dB	– 36.0 dBm
± 0.20 MHz	–30.0 dB	– 30.0 dB	– 36.0 dBm
± 0.25 MHz	–33.0 dB	– 33.0 dB	– 36.0 dBm
± 0.40 MHz	–60.0 dB	– 60.0 dB	– 36.0 dBm
± 0.60 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 0.80 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.00 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.20 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.40 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.60 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.80 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm

Default values for GSM1800/1900:

Frequency	Min.P. Lev.rel.	Max.P. Lev.rel.	Level abs.
± 0.10 MHz	+0.5 dB	+ 0.5 dB	– 36.0 dBm
± 0.20 MHz	–30.0 dB	– 30.0 dB	– 36.0 dBm
± 0.25 MHz	–33.0 dB	– 33.0 dB	– 36.0 dBm
± 0.40 MHz	–60.0 dB	– 60.0 dB	– 36.0 dBm
± 0.60 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 0.80 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.00 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.20 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.40 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.60 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.80 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm

CONFigure:SPECtrum:MODulation:LIMit:LINE:REFPower[:UPPer] ***<Minimum>, <Maximum>*** Reference power

Parameters	Value range	Description of parameters	Def. value
<Minimum>,	-99.9 dBm to 99.9 dBm	Reference power for the minimum power level	33 dBm
<Maximum>	-99.9 dBm to 99.9 dBm	Reference power for the maximum power level	39 dBm

Description of command	Status	FW vers.
This command defines the MS output power range where the relative limit lines are given by linear interpolation between a minimum and a maximum relative power level. See command `CONFigure:SPECtrum:MODulation:LIMit:LINE:UPPer<nr>` and detailed explanation in chapter 4. The value range applies with the additional condition `<Minimum> ≤ <Maximum> – 1dB.`	all	V1.25

CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer] ***<Mode>*** Limits on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Switch on limit lines	ON	–	–
OFF	Switch off limit lines			

Description of command	Status	FW vers.
This command switches all limit lines for the spectrum due to modulation measurement on or off.	all	V1.20

CONFigure:SPECtrum:MODulation:LIMit:LINE:DEFault ***<Enable>*** Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem are set to default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			

Description of command	Status	FW vers.
If used as a setting command with *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.	all	2.0

Subsystem SUBarrays:SPECtrum:MODulation

The subsystem *SUBarrays:SPECtrum:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum:MODulation <Mode>,<Range>{,<Range>} Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>	**Description of parameters**	**Def. value**	**Def. unit**	**Unit ring**
–1.8 MHz to 1.8 MHz,	Frequency of first point in current range	NAN	MHz	
1 to 23	Number of samples in current range	NAN	–	

Description of command	Status	FW vers.
This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:MODulation` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located at fixed frequencies (see command `CONFigure:SPECtrum:MODulation:LIMit:LINE<nr>`). The subranges may overlap but must be within the total range of the *spectrum due to modulation* measurement. If the combination of start frequency and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.	all	2.0

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to modulation measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:MODulation[:RESult]

The subsystem *SPECtrum:MODulation[:RESult]* measures and returns the frequency spectum (due to modulation) and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum.*

Scalar Results

READ[:SCALar]:SPECtrum:MODulation[:RESult]?	Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:MODulation[:RESult]?	Read measurement results (unsynchronized)
SAMPle[:SCALar]:SPECtrum:MODulation[:RESult]?	Read measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
Reference Power,	–100.0 dBm to +100.0 dBm	NAN	dBm	
Matching	INV | MATC | NMAT | OUT | NTR | BNF | OFF	INV	–	

Description of command	Status	FW vers.
These commands are always queries.	all	V1.20

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the current results regardless of the measurement state.
- `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The reference power is the absolute carrier power measured as specified in the GSM standard. The following messages may be output for the value *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no Trigger*
BNF	*burst not found*
OFF	*off*

Spectrum Results

READ:ARRay:SPECtrum:MODulation[:RESult]? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MODulation[:RESult]? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MODulation[:RESult]? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB,	Power at measurement point 1	NAN	dB	FG
...,	...	...	...	Power
–100.0 dB to + 20.0 dB	Power at measurement point *n*	NAN	dB	Level

Description of command	Status	FW vers.
These commands are always queries. They return the off-carrier power due to modulation at the measurement points defined via the command `CONFigure:ARRay:SPECtrum:MODulation:RANGe`.	all	V1.20

READ:SUBarrays:SPECtrum:MODulation[:RESult]? Subarray Results
Start single shot measurement and return results *RUN*
FETCh:SUBarrays:SPECtrum:MODulation[:RESult]?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:SPECtrum:MODulation[:RESult]?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	Power[1], 1st value for power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	Power[x], xth value for power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the off-carrier power due to modulation in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:MODulation` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:SPECtrum:MODulation` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange.	all	2.0

Test Object SPECtrum due to SWITching

The subsystem *SPECtrum:SWITching* measures the off-carrier power due to the bursty nature of the GSM signal. The subsystem corresponds to the measurement menu *Spectrum* and the associated configuration popups.

Control of Measurement – Subsystem SPECtrum:SWITching

The subsystem *SPECtrum:SWITching* controls the spectrum due to switching measurement.

INITiate:SPECtrum:SWITching **ABORt:SPECtrum:SWITching** **STOP:SPECtrum:SWITching** **CONTinue:SPECtrum:SWITching**	Start new measurement Abort running measurement and switch off Stop measurement after current stat. cycle Next measurement step (only *stepping mode*)		*RUN* *OFF* *STOP* *RUN*
Description of command		Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status indicated in the top right column.		all	V1.20

CONFigure:SPECtrum:SWITching:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	–
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).			all	V1.20

FETCh:SPECtrum:SWITching:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	–
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	–
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	V1.20

Subsystem SPECTrum:SWITching:CONTrol

The subsystem *SPECtrum:SWITching:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Statistics* tabs in the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:SWITching:CONTrol *<Mode>,<Statistics>* Scope of Measurement

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Only scalar measured values Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	10	–	–
Description of command			Status	FW vers.
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.			all	V1.20

CONFigure:SPECtrum:SWITching:CONTrol:REPetition *<Repetition>,<StopCondition>, <Stepmode>* Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot*			all	V1.20

DISPlay:SPECtrum:SWITching:CONTrol:GRID *<Enable>* Grid

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	–
Description of command			Status	FW vers.
This command switches the grid lines in the test diagrams on or off.			all	V1.20

CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle <Enable>
Enable/Disable Measurement Points

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on measurement point <nr> Switch off measurement point <nr>	ON	–	–

Description of command	Status	FW vers.
This command switches the measurement at the individual frequency points no. 1 to 4 (numbered by the numeric suffix <nr>) on or off.	all	V1.20

CONFigure:SPECtrum:SWITching:CONTrol:DEFault *<Mode>* Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem correspond to their default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.	all	2.0

Test Configuration

The commands of the following subsystems configure the spectrum due to switching. They correspond to the *due to Switching* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:SWITching:LIMit:LINE

The subsystem *SPECtrum:SWITching:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to switching measurement. The subsystem corresponds to the *due to Switching* sections in the index card *Limit Lines* in the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:SWITchingLIMit:LINE[:UPPer]<nr>:ENABle <Enable>
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr> Limits

<PowerLevel>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>, <Enable>

Numeric Suffix	Value range	Description of parameters	Def. value
<nr>	1 to10	Power level no.	
Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Defined section on/off	See below
<Power level>,	–100 dBm to 30 dBm	MS output power for power level <nr>	See below
<Limit at 0.4 MHz>,	–100 dBm to 30 dBm	Limit for the measurement point at: 0.4 MHz from carrier frequency	See below
<Limit at 0.6 MHz>,	–100 dBm to 30 dBm	0.6 MHz from carrier frequency	
<Limit at 1.2 MHz>,	–100 dBm to 30 dBm	1.2 MHz from carrier frequency	
<Limit at 1.8 MHzl>,	–100 dBm to 30 dBm	1.8 MHz from carrier frequency	
<Enable>	ON | OFF| DEFault	Enable or disable limit check for power level <nr>	See below

Description of command	Status	FW vers.
These commands activate and define limit lines for the spectrum due to switching measurement. The value range for the individual power levels <nr> at the same frequency applies with the additional conditions	all	V1.20

`<PowerLevel(n+1)> ≤ <PowerLevel(n)> – 1 dB` and
`|<PowerLevel(n+1)> – <PowerLevel(n)>| ≤ 100 dB.`

The limits are defined depending on 10 definable MS output power levels numbered by the numeric suffix <nr> and four fixed frequency offsets from the carrier. The first parameter defines the power of level no. <nr>. For the 1st and the 10th level, limit values are entered: The levels then comprise all powers greater than or less than the specified limits.

For switching on or off one measurement point over all power levels, please use the command

```
CONFigure:SPECtrum:SWITching:LIMit:LINE:ENABle[:UPPer]
```

For totally switching on or off the limit check please use the command

```
CONFigure:SPECtrum:SWITching:LIMit:LINE:MODE[:UPPer]
<Mode>
```

Default values for GSM900:

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 39.0	–13.0	–21.0	–21.0	–24.0
2	37.0	–15.0	–21.0	–21.0	–24.0
3	35.0	–17.0	–21.0	–21.0	–24.0
4	33.0	–19.0	–21.0	–21.0	–24.0
5	31.0	–21.0	–23.0	–23.0	–26.0
6	29.0	–23.0	–25.0	–25.0	–28.0
7	27.0	–23.0	–26.0	–27.0	–30.0
8	25.0	–23.0	–26.0	–29.0	–32.0
9	23.0	–23.0	–26.0	–31.0	–34.0
10	≤ 21.0	–23.0	–26.0	–32.0	–36.0

Default values for GSM1800:

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 36.0	–16.0	–21.0	–21.0	–24.0
2	34.0	–18.0	–21.0	–21.0	–24.0
3	32.0	–20.0	–22.0	–22.0	–25.0
4	30.0	–22.0	–24.0	–24.0	–27.0
5	28.0	–23.0	–25.0	–26.0	–29.0
6	26.0	–23.0	–26.0	–28.0	–31.0
7	24.0	–23.0	–26.0	–30.0	–33.0
8	22.0	–23.0	–26.0	–31.0	–35.0
9	≤ 20.0	–23.0	–26.0	–32.0	–36.0

Default values for GSM1900:

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 33.0	–19.0	–22.0	–22.0	–25.0
2	32.0	–20.0	–22.0	–22.0	–25.0
3	30.0	–22.0	–24.0	–24.0	–27.0
4	28.0	–23.0	–25.0	–26.0	–29.0
5	26.0	–23.0	–26.0	–28.0	–31.0
6	24.0	–23.0	–26.0	–30.0	–33.0
7	22.0	–23.0	–26.0	–31.0	–35.0
8	≤ 20.0	–23.0	–26.0	–32.0	–36.0

CONFigure:SPECtrum:SWITchingLIMit:LINE:ENABle[:UPPer] Limit Check on/off
<MP04>, <MP06>, *<MP12>*, <MP18>

Parameters	Value range	Description of parameters	Def. value
		Switch limit check on or off for all power levels at the measurement point	
<MP04>	ON | OFF	0.4 MHz from carrier frequency	ON
<MP06>,	ON | OFF	0.6 MHz from carrier frequency	ON
<MP12>,	ON | OFF	1.2 MHz from carrier frequency	ON
<MP18>	ON | OFF	1.8 MHz from carrier frequency	ON

Description of command	Status	FW vers.
This command switches the limit check at the four measurement points on or off.	all	V1.20

CONFigure:SPECtrum:SWITchingLIMit:LINE:MODE[:UPPer] *<Mode>* Limits on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Switch on limit lines	ON	–	–
OFF	Switch off limit lines			

Description of command	Status	FW vers.
This command switches all limits for the spectrum due to switching measurement on or off.	all	V1.20

CONFigure:SPECtrum:SWITching:LIMit:LINE:DEFault *<Enable>* Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem are set to default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			

Description of command	Status	FW vers.
If used as a setting command with *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.	all	2.0

Subsystem SUBarrays:SPECtrum:SWITching

The subsystem *SUBarrays:SPECtrum:SWITching* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum:SWITching <Mode>,<Range>{,<Range>}
Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>	Description of parameters	Def. value	Def. unit	Unit ring
–1.8 MHz to 1.8 MHz,	Frequency of first point in current range	NAN	MHz	
1 to 9	Number of samples in current range	NAN	–	

Description of command	Status	FW vers.
This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:SWITching` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located at fixed frequencies (see command `CONFigure:SPECtrum:SWITching:LIMit:LINE<nr>`). The subranges may overlap but must be within the total range of the *spectrum due to switching* measurement. If the combination of start frequency and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.	all	2.0

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to switching measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:SWITching[:RESult]

The subsystem *SPECtrum:SWITching[:RESult]* measures and returns the frequency spectum (due to switching) and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum*.

	Scalar Results:
READ[:SCALar]:SPECtrum:SWITching[:RESult]?	Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:SWITching[:RESult]?	Read measurement results (unsynchronized)
SAMPle[:SCALar]:SPECtrum:SWITching[:RESult]?	Read measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
Reference Power,	–100.0 dBm to +100.0 dBm	NAN	dBm	
Matching	INV | MATC | NMAT | OUT | NTR | BNF | OFF	INV	–	

Description of command	Status	FW vers.
These commands are always queries.	all	V1.20

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the results without taking care of the measurement state.
- `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The reference power is the absolute carrier power measured as specified in the GSM standard. The following messages may be output for the value *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no Trigger*
BNF	*Burst not found*
OFF	*off*

	Spectrum Result
READ:ARRay:SPECtrum:SWITching[:RESult]?	Start single shot measurement and return results
FETCh:ARRay:SPECtrum:SWITching[:RESult]?	Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:SWITching[:RESult]?	Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 100.0 dB,	Power at measurement point 1	NAN	dBm	FG Power Level
...,	...	...	...	
–100.0 dB to + 100.0 dB	Power at measurement point *n*	NAN	dBm	

Description of command	Status	FW vers.
These commands are always queries. They return the off-carrier power due to switching at the measurement points defined via the command `CONFigure:ARRay:SPECtrum:SWITching:RANGe`.	all	V1.20

	Subarray Results	
READ:SUBarrays:SPECtrum:SWITching[:RESult]?	Start measurement and return results	*RUN*
FETCh:SUBarrays:SPECtrum:SWITching[:RESult]?	Read meas. results (unsynchronized)	*RUN*
SAMPle:SUBarrays:SPECtrum:SWITching[:RESult]?	Read results (synchronized)	*RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 100.0 dB	Power[1], 1st value for power	NAN	dB	
...	...	...	...	
–100.0 dB to + 100.0 dB	Power[x], xth value for power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the off-carrier power due to switching in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:SWITching` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:SPECtrum:SWITching` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned by subrange.	all	2.0

GSM Measurements with Signalling

Group Configuration

The remote-control commands in this section are used to configure the measurements in the menu group *GSM900/1800/1900-MS Signalling* globally. They correspond to the settings in the popup menu of the softkey *Group Config.* located to the left of the headline of each main menu (see chapter 3).

Subsystem LEVel (Input Level)

The subsystem *LEVel* determines or modifies the input level for the currently used input. It corresponds to the index card *Input Level* in the popup menu *Group Configuration*.

[SENSe:]LEVel:MODE *<Mode>*				Input level – setting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
MANual | **PCLevel**	Manual setting of max. input level According to power control level of the mobile	PCLevel	–	–
Description of command			Status	FW vers.
This command defines the mode for setting the maximum input level.			all	≥1.15

[SENSe:]LEVel:MAXimum *<Level>*				Max. Level
<Level>	Description of parameters	Def. value	Def. unit	Unit ring
0 dBm to +47 dBm **–14 dBm to 33 dBm** **–37 dBm to 0 dBm**	Maximum input level for RF 1 Maximum input level for RF 2 Maximum input level for RF 4 IN	0.0	dBm	
Description of command			Status	FW vers.
This command defines the maximum input level. The permissible value range depends on the RF input used and the external attenuation set (see `[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]` command).			all	≥1.15

[SENSe:]LEVel:ATTenuation *<Mode>*				Attenuation
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
NORMal | **LNOise |** **LDIStortion**	Normal (input level is maintained) Low noise, CMU at full-range level Low distortion (high transmission reserve)	NORMal	–	–
Description of command			Status	FW vers.
This command defines the attenuation or gain factor for the RF input signal.			all	≥1.15

[SENSe:]LEVel:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	–

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*	all	2.0

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* defines the trigger mode. It corresponds to the index card *Trigger* in the popup menu *Group Configuration.*

TRIGger[:SEQuence]:SOURce *<Source>*				Source
<Source>	Description of parameters	Def. value	Def. unit	Unit ring
SIGNalling	The measurement is triggered by the signalling unit	SIGN	–	–
FRUN |	The measurement is triggered by the TDMA timing (free-run mode) of the analyzed signal.			
RFPower |	Wide-band power trigger.			
IFPower	Narrow-band trigger.			

Description of command	Status	FW vers.
This command defines the trigger mode. The setting *FRUN* assumes burst signals with incorporated training sequence.	all	≥1.15

TRIGger[:SEQuence]:THReshold *<Threshold>*				Level
<Threshold>	Description of parameters	Def. value	Def. unit	Unit ring
LOW |	Low trigger threshold (reference level –26 dB)	LOW	–	–
MEDium |	Medium trigger threshold (ref. level –16 dB)			
HIGH	High trigger threshold (reference level –6 dB)			

Description of command	Status	FW vers.
This command sets the threshold at which the trigger signal (cf. `TRIGger[:SEQuence]:SOURce`) triggers the measurement.	all	≥1.15

TRIGger[:SEQuence]:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	–

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*	all	2.0

Connection Control

The remote-control commands presented in this section control the signalling (call setup and cleardown, services, signalling parameters), determine the inputs and outputs as well as the reference frequency. They correspond to the settings in the popup menu of the softkey *Connect. Control* located to the right of the headline of each main menu (see chapter 4).

Signalling – Subsystem SIGNalling (Call Setup and Cleardown)

The subsystem *SIGNalling* controls the call setup and cleardown from the CMU to the mobile and determines the signalling parameters. Together with the subsystem *SPOWer* (see below) it corresponds to the four index cards *Signalling* (for four different signalling states, see command `PROCedure:SIGNalling:ACTion`) in the popup menu *Connect. Control*.

PROCedure:SIGNalling:ACTion *<Action>*				Signalling Control
<Action>	Description of parameters	Def. value	Def. unit	Unit ring
SOFF |	Switch off BCCH signal *(signal off)*	SON	–	–
SON |	Switch on BCCH signal *(signal on)*			
MTC |	Mobile terminating call			
SMS |	Short message service			
CRELease |	Call release			
HANDover	Handover			
Description of command			Status	FW vers.
This command changes between the different signalling states of the CMU.			See below	≥1.15

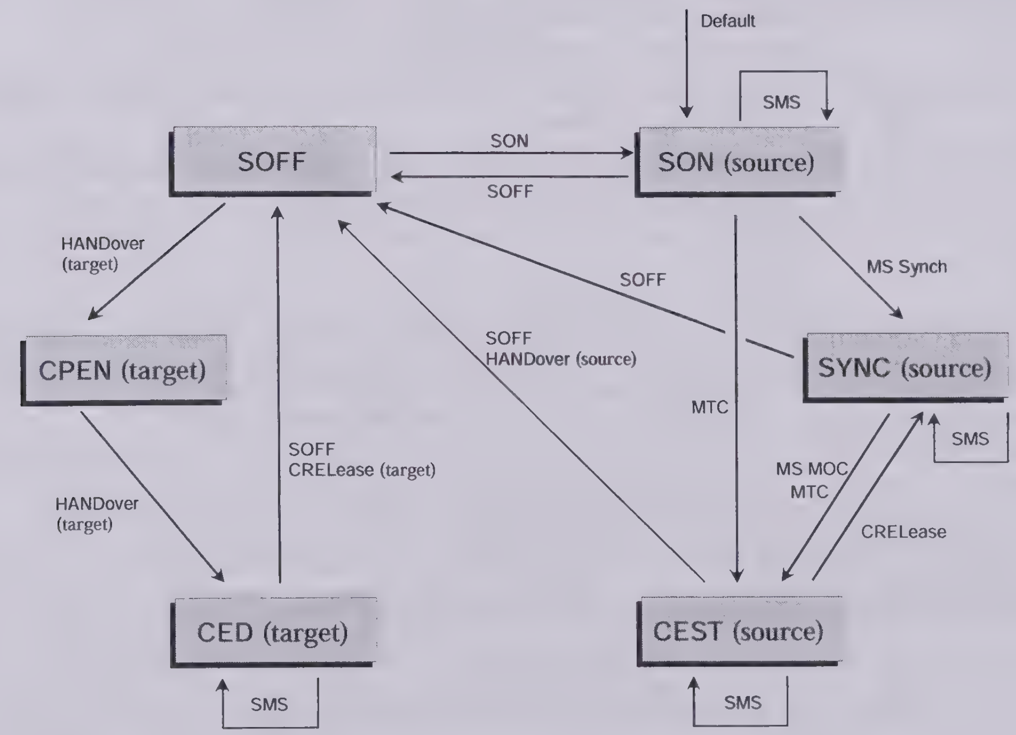
Default
SMS
SOFF
SON
SOFF
SON (source)
HANDover (target)
SOFF
MS Synch
CPEN (target)
SOFF
HANDover (source)
SYNC (source)
MTC
SMS
SOFF
CRELease (target)
MS MOC
MTC
HANDover (target)
CRELease
CED (target)
CEST (source)
SMS
SMS

Fig. 6-1: Signalling states of the CMU and transitions including handover

Signalling states:

SOFF	signal off	CEST	call established
SON	signal on	CPEN	call pending
SYNC	synchronized	CED	call established dual band

Actions:	*initiated from the CMU:*	*initiated from the mobile phone:*	
	See description of command	MS Synch	Synchronization of mobile phone
		MS MOC	Mobile originated call

Further transitions between the signalling states (not shown in Fig. 6-1) may occur, e.g. in case of errors.

[SENSe:]SIGNalling:STATe? Signalling State

Return	Description of parameters	Def. value	Def. unit	Unit ring
SOFF |	Signal for synchronization switched off *(signal off)*	SON	–	–
SON |	Signal for synchronization switched on *(signal on)*			
SYNC |	Synchronization of CMU and mobile phone and location update established *(synchronized)*			
CEST |	Call to mobile set up *(call established)*			
CPEN |	Call pending			
CED	Call established dual band			

Description of command	Status	FW vers.
This command is always a query. It reads out the current signalling state.	all	≥1.15

PROCedure:SIGNalling:CHCCombined <ChannelNumber>, <Timeslot>, <PCL> Combined Channel/TS/PCL Change

<ChannelNumber>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62	–	–
512 to 885	Number of traffic channel, GSM1800	740	–	–
512 to 810	Number of traffic channel, GSM1900	610	–	–
<Timeslot>>	Description of parameters	Def. value	Def. unit	Unit ring
2 to 6	Timeslot of traffic channel	3	–	–
<PCL>	Description of parameters	Def. value	Def. unit	Unit ring
	Power of mobile phone in PCL units,			
0 to 19	GSM900	15	PCL	–
0 to 31	GSM1800	10	PCL	–
0 to 31	GSM1900	10	PCL	–

Description of command	Status	FW vers.
This command controls the combined channel change, the number of the traffic channel for signals of the CMU, the timeslot for this channel and the mobile power level being changed at the same time. Thus, the command combines the three commands `PROCedure:SIGNalling[:TCH]:CHANnel <Number>,` `PROCedure:SIGNalling[:TCH]:TIMeslot <Timeslot>`, and `PROCedure:SIGNalling:MS:PCL <PCL>` (see below). The GSM PCL levels are listed in chapter 4 (see list of tables or index).	CEST	≥1.15

PROCedure:SIGNalling[:TCH]:CHANnel ***<Number>*** Traffic Channel

<Number>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62		
512 to 885	Number of traffic channel, GSM1800	740		
512 to 810	Number of traffic channel, GSM1900	610		

Description of command	Status	FW vers.
This command changes the traffic channel number (and thus the frequency) for signals of the CMU while a call is established.	CEST	≥1.15

PROCedure:SIGNalling[:TCH]:FHOPping:SEQuence ***<Sequence>*** Hopping

<Sequence>	Description of parameters	Def. value	Def. unit	Unit ring
A | B | C | D |	Select hopping sequence	OFF	–	–
OFF	Switch off frequency hopping			

Description of command	Status	FW vers.
This command selects one out of the four possible hopping sequences for the traffic channel or switches frequency hopping off.	CEST	≥1.15

PROCedure:SIGNalling[:TCH]:TIMeslot ***<Timeslot>*** Timeslot

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
2 to 6	Timeslot of traffic channel	3	–	–

Description of command	Status	FW vers.
This command changes the traffic channel timeslot while a call is established.	CEST	≥1.15

PROCedure:SIGNalling:MS:PCL ***<PCL>*** PCL

<PCL>	Description of parameters	Def. value	Def. unit	Unit ring
	Power of mobile phone in PCL units,			
0 to 19	GSM900	15	PCL	–
0 to 31	GSM1800	10	PCL	–
0 to 31	GSM1900	10	PCL	–

Description of command	Status	FW vers.
This command commands the mobile phone to change its power control level while a call is established. The range depends on the GSM phase of the mobile (see chapter 4).	CEST	≥1.15

[SENSe:]SIGNalling:SMS? Short Message Service Text

Return	Description of parameters	Def. value	Def. unit	Unit ring
String	Short message received	""	–	–

Description of command	Status	FW vers.
This command is always a query. It reads the short message received.	All	V2.0

CONFigure:SIGNalling:SMS ***<Text>*** Short Message Service Text

<Text>	Description of parameters	Def. value	Def. unit	Unit ring
String	Short message to be sent	""	–	–

Description of command	Status	FW vers.
This command defines a short message in the form of any alphanumeric string with a maximum of 160 characters.	All	V2.0

Subsystem HANDover (Handover Target)

The subsystem *HANDover* sets the target for a forced handover of the mobile phone. The corresponding softkeys are located in the index card *Handover* in the popup menu *Connect. Control.*

STATus:HANDover:TARGet:LIST?				Destination List
Response	Description of parameters	Def. value	Def. unit	Unit ring
"GSM1800MsDualBand", **"GSM1900MsDualBand"** **"GSM900MsDualBand"**	Target list for GSM900 Target list for GSM1800/1900	– –	– –	– –
Description of command			Status	FW vers.
This command is always a query and returns a list of all networks that are available for a handover. The list depends on the current network.			CEST	≥2.0

CONFigure:HANDover:TARGet *<Target>*				Destination Selection
<Target>	Description of parameters	Def. value	Def. unit	Unit ring
"GSM1800MsDualBand" | **"GSM1900MsDualBand" |** **"GSM900MsDualBand" |** **NONE**	Possible target for GSM900 Possible target for GSM900 Possible target for GSM1800/1900 No handover	NONE	–	–
Description of command			Status	FW vers.
This command selects a handover target. The targets available depend on the current network. The handover itself is started via the `PROCedure:SIGNalling:ACTion HANDover` command.			CEST	≥2.0

Subsystem BSSignal (Signal of Base Station/CMU)

The subsystem *BSSignal* configures the control and traffic channels for the signals sent by the CMU to the mobile phone. It corresponds to the index card *BS Signal* in the popup menu *Connect. Control.*

CONFigure:BSSignal:CCH:CHANnel *<CCHChannel>*				Control Channel
<CCHChannel>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 124 | 955 to 1023 **512 to 885** **512 to 810**	Channel number for GSM900 Channel number for GSM1800 Channel number for GSM1900	62 735 600	– – –	
Description of command			Status	FW vers.
This command determines the control channel for the CMU signals (BCCH).			SON, SOFF	≥1.15

CONFigure:BSSignal:CCH:LEVel[:ABSolute] *<Level>*				Control Channel Level
<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–137 dBm to –27 dBm **–137 dBm to –10 dBm** **–90 dBm to +13 dBm**	Absol. level of control channel, RF1 Absol. level of control channel, RF2 Absol. level of control channel, RF 3 OUT	–85 –85 –85	dBm dBm dBm	
Description of command			Status	FW vers.
This command determines the level of the control channel in absolute units.			SON, SOFF SYNC	≥1.15

CONFigure:BSSignal[:TCH]:CHANnel *<TCHChannel>* Traffic Channel

<TCHChannel>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 124 | 955 to 1023	Channel number for GSM900	62	–	–
512 to 885	Channel number for GSM1800	711	–	
512 to 810	Channel number for GSM1900	661	–	

Description of command	Status	FW vers.
This command determines the number of the traffic channel.	SON, SOFF SYNC Q: all	≥1.15

PROCedure:BSSignal[:TCH]:FHOPping:SEQuence *<Sequence>* Hopping List

<Sequence>	Description of parameters	Def. value	Def. unit	Unit ring
A | B | C | D |	Select hopping sequence	OFF	–	–
OFF	Switch off frequency hopping			

Description of command	Status	FW vers.
After the call has been set up, this command selects a hopping sequence for the CMU signals or switches off frequency hopping. The hopping sequences can be configured via the `CONFigure:BSSignal[:TCH]:FHOPping:A|B|C|D` commands, see below.	CEST	≥1.15

CONFigure:BSSignal[:TCH]:FHOPping:A *<Channel>{,<Channel>}*
CONFigure:BSSignal[:TCH]:FHOPping:B *<Channel>{,<Channel>}*
CONFigure:BSSignal[:TCH]:FHOPping:C *<Channel>{,<Channel>}*
CONFigure:BSSignal[:TCH]:FHOPping:D *<Channel>{,<Channel>}* Edit Hopping Sequence

<Channel>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 124, 955 to 1023 |	Sequence of up to 64 GSM channels, depending on the GSM band used,	see below	–	–
OFF	undefined channel number			

Description of command	Status	FW vers.
After the call has been set up, these commands define hopping sequences that supersede the four GSM standard hopping sequences A to D quoted below. The sequence may consist of up to 64 arbitrary GSM channel numbers; however, a query returns each hopping sequence in ascending order. Undefined channels are set to *OFF*.	SON, SOFF SYNC	1.20

For GSM900, the following four default sequences are available:

Sequence A:	5, 9, 16, 23, 28, 30, 34, 39, 44, 48, 51, 54, 59, 64, 69, 73, 75, 79, 82, 86, 89, 92, 96, 98, 101, 106, 109, 113, 117, 121, OFF, ... OFF
Sequence B:	4, 12, 17, 19, 23, 25, 29, 33, 36, 41, 45, 47, 53, 61, 63, OFF,...OFF
Sequence C:	65, 68, 72, 76, 79, 81, 84, 88, 91, 93, 98, 102, 105, 112, OFF, ... OFF
Sequence D:	1, 62, 124, OFF, ... OFF

For GSM1800, the following four default sequences are available:

Sequence A:	533, 559, 568, 592, 604, 617, 631, 642, 678, 697, 722, 743, 759, 796, 811, 824, OFF, ... OFF
Sequence B:	513, 518, 527, 533, 541, 545, 553, 562, 570, 577, 585, 597, OFF,...OFF
Sequence C:	755, 761, 773, 777, 788, 796, 801, 807, 816, 824, 829, 833, 847 OFF, ... OFF
Sequence D:	512, 698, 885, OFF, ... OFF

For GSM1900, the following four default sequences are available:

Sequence A: 533, 559, 568, 592, 604, 617, 631, 642, 678, 697, 722, 743, 759, 796, OFF, ... OFF

Sequence B: 513, 518, 527, 533, 541, 545, 553, 562, 570, 577, 585, 597, OFF,...OFF

Sequence C: 755, 761, 773, 777, 788, 796, 801, 807, OFF, ... OFF

Sequence D: 512, 660, 810, OFF, ... OFF

PROCedure:BSSignal:TIMing:ADVance <*Bit*>
CONFigure:BSSignal:TIMing:ADVance <*Bit*>

Timing Advance

<Bit>	Description of parameters	Def. value	Def. unit	Unit ring
0 Bit to 63 Bit	Correction of the mobile's timing	0	Bit	

Description of command	Status	FW vers.
This command determines the correction of the mobile's time scale in bits. The `CONFigure...` command is available in the signalling states SOFF, SON, and SYNC. It configures the traffic channel before it is switched on. The `PROCedure...` command is available in the signalling state CEST. With an established call it changes the timing advance setting of the current call.	all	≥2.0

CONFigure:BSSignal[:TCH]:TIMeslot <*Timeslot*>

Timeslot

<Timeslot>	Description of parameters	Def. value	Def. unit	Unit ring
2 to 6	Number of timeslot;	3	–	–

Description of command	Status	FW vers.
This command determines the timeslot for the traffic channel.	SON, SOFF SYNC	≥1.15

CONFigure:BSSignal[:TCH]:LEVel:UTIMeslot <*Level*>
PROCedure:BSSignal[:TCH]:LEVel:UTIMeslot <*Level*>

Used Timeslot Level

<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–137 dBm to –27 dBm	RF1 level in used timeslot	–90	dBm	
–137 dBm to –10 dBm	RF2 level in used timeslot	–90	dBm	
–90 dBm to +13 dBm	RF 3 OUT level in used timeslot	–90	dBm	

Description of command	Status	FW vers.
This command determines the absolute level in the used timeslot. The permissible value range depends on the RF output of the CMU used. The `CONFigure...` command is available in the signalling states SOFF, SON, and SYNC. It configures the traffic channel before it is switched on. The `PROCedure...` command is available in the signalling state CEST. With an established call it changes the signal level, resets the device hardware to the new signal level and continues the measurement.	all	≥1.15

CONFigure:BSSignal[:TCH]:LEVel:UNTimeslot <*Level*>
PROCedure:BSSignal[:TCH]:LEVel:UNTimeslot <*Level*>>

Unused Timeslot Level

<*Level*>	Description of parameters	Def. value	Def. unit	Unit ring
–47 dB to 63 dB	RF1 level in unused timeslot	–20	dB	
–47 dB to 80 dB	RF2 level in unused timeslot	–20	dB	
0 dB to +130 dB	RF 3 OUT level in unused timeslot			

Description of command	Status	FW vers.
This command determines the (relative) level in the unused timeslots. The value range given above is valid with the restriction that the sum of the absolute level of the used timeslot and the relative value for the unused timeslot does not exceed the value ranges for the absolute level of the used timeslot (for RF 1, RF 2 and RF OUT 3). The `CONFigure...` command is available in the signalling states SOFF, SON, and SYNC. It configures the traffic channel before it is switched on. The `PROCedure...` command is available in the signalling state CEST. With an established call it changes the signal level, sets the device hardware to the new signal level and continues the measurement.	all	≥1.15

CONFigure:BSSignal:FM:DEViation <*FrequencyOffset*>

Frequency Offset

<*FrequencyOffset*>	Description of parameters	Def. value	Def. unit	Unit ring
–100 kHz to +100 kHz	Frequency offset	0.0	Hz	

Description of command	Status	FW vers.
This command determines a frequency offset for the CMU signals (CCH and TCH).	SOFF, SON, SYNC	≥1.15

CONFigure:BSSignal:SPEech <*Mode*>
PROCedure:BSSignal:SPEech <*Mode*>

Speech Mode

<*Mode*>	Description of parameters	Def. value	Def. unit	Unit ring
ECHO |	*loop back* in the CMU with delay	ECHO	–	–
LOOP |	*loop back* in the CMU with minimal delay			
PR9 |	2^9-1 PSR bit pattern			
PR11 |	2^{11}-1 PSR bit pattern			
PR15 |	2^{15}-1 PSR bit pattern			
PR16 |	2^{16}-1 PSR bit pattern			
HANDset	Speech coder/decoder operation			

Description of command	Status	FW vers.
This command determines the type of data transmitted in the traffic channel. For BER measurements, one of the pseudo random sequences (PSR) must be used. The `CONFigure...` command is available in the signalling states SOFF, SON, and SYNC. It configures the traffic channel before it is switched on. The `PROCedure...` command is available in the signalling state CEST. With an established call it changes the speech mode, resets the device hardware to the new speech mode and continues the measurement.	all	≥1.15

Subsystem NETWork

The subsystem *NETWork* determines the parameters of the radio network and the existing radio link. The subsystem corresponds to the popup menu *Network* in the menu group *Connect. Control.*

CONFigure:NETWork:AOCharge:ENABle *<Enable>* Advice of Charge
CONFigure:NETWork:AOCharge *<Value1>, <Value2> ... , <Value7>*

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch on or off data for advice of charge	ON	–	–
<Value n> ...	Description of parameters	Def. value	Def. unit	Unit ring
0 to 8191	Values 1 to 7 for calculating the charges	0.0,0.0,0.0,0	–	–
Description of command			Status	FW vers.
The seven numbers denote the following:	Units per interval Seconds / time interval Scaling factor Unit increment Units per data interval Segments / data interval Initial secs / t interval		SOFF, SON SYNC Q: All	V1.15

CONFigure:NETWork:BAList *<Channel> {,<Channel>}* BA List

<Channel>	Description of parameters	Def. value	Def. unit	Unit ring
0 to124, 955 to1023 | **OFF**	BCCH ch. numbers for GSM900 BA list switched off	10,120,OFF,...,OFF	–	–
512 to 885 | OFF	Channel numbers for GSM1800	520,620,OFF,...		
512 to 810 | OFF	Channel numbers for GSM1900	550,700,OFF,...		
Description of command			Status	FW vers.
This command generates the list of up to 15 used channels in the adjacent cells (BA list, *BCCH allocation list)*. In the query format, the command returns the channel numbers in the BA list.			SOFF, SON SYNC Q: all	≥1.15

Subsystem NETWork:REQuest (Request Mobile Data)

The subsystem *NETWork:REQuest* determines the signalling parameters of the mobile to be requested. The subsystem corresponds to the table field *Requested Mobile Data* in the popup menu *Network.*

CONFigure:NETWork:REQuest:IMSI *<Mode>* IMSI Request

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	IMSI requested No request	ON	–	–
Description of command			Status	FW vers.
This command determines whether the international mobile subscriber identity of the connected mobile phone is requested during *location update, call to mobile, call from mobile,* or *SMS transfer.*			SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:REQuest:IMEI *<Mode>*				IMEI Request
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	IMEI requested No request	ON	–	–

Description of command	Status	FW vers.
This command determines whether the international mobile station equipment identity (IMEI) of the connected mobile is requested during *location update, call to mobile, call from mobile,* or *SMS transfer.*	SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:REQuest: AUTHenticate *<Mode>*				Authentication Request
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Authentication request No request	OFF	–	–

Description of command	Status	FW vers.
This command determines whether an authentication request of the connected mobile is made during *location update, call to mobile, call from mobile*, or *SMS transfer.*	SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:REQuest:HANDover *<Mode>*				Handover Request
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Handover request No handover request	ON	–	–

Description of command	Status	FW vers.
This command determines whether the capability to perform a handover is requested on the connected mobile during *location update, call to mobile, call from mobile*, or *SMS transfer.*	SOFF, SON SYNC Q: all	≥1.15

Subsystem NETWork[:MS] (Mobile settings)

The subsystem *NETWork[:MS]* defines the mobile parameters. The subsystem corresponds to the table field *Mobile Settings* in the popup menu *Network*.

CONFigure:NETWork[:MS]:DTX *<Mode>*				DTX
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Transmission with interruption not possible Transmission with interruption possible	OFF	–	–

Description of command	Status	FW vers.
This command permits the mobile to make use of the DTX mode *(discontinuous transmission mode)*. The status assumed by the mobile is to be determined using the command `[SENSe:]RREPorts:DTX?`. Only useful data are transferred in DTX mode; if nothing is spoken, the mobile will transmit nothing in the traffic frames.	SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork[:MS]:POWer *<Level>*				PCL Level
<Level>	Description of parameters	Def. value	Def. unit	Unit ring
	Power of mobile phone in PCL units,			
0 to 19	GSM900	15	PCL	–
0 to 31	GSM1800	10	PCL	–
0 to 31	GSM1900	10	PCL	–
Description of command			Status	FW vers.
This command defines the mobile power level upon registration in the network. An overview of power control levels (PCL) in GSM is given in chapter 4 (see table or index).			SOFF, SON SYNC Q: all	≥1.15

Subsystem NETWork:SMODe (Type of Signalling)

The subsystem *NETWork:SMODe* defines the signalling parameters referring to the function of the mobile. The subsystem corresponds to the table field *Signalling Modes* in the popup menu *Network.*

CONFigure:NETWork:SMODe:LOCupdate *<Mode>*				Location Update
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALWays |	Location update each time the mobile is switched on	ALW	–	–
AUTO	Only if necessary			
Description of command			Status	FW vers.
This command determines in which cases the mobile performs a location update.			SOFF SON SYNC Q: All	V1.20

					Default IMSI:
CONFigure:NETWork:SMODe:IMSI:MNC *<MNC>*					Mobile Network Code
CONFigure:NETWork:SMODe:IMSI:MCC <MCC>					Mobile Country Code
CONFigure:NETWork:SMODe:IMSI:MSIN *<MSIN>*					Mobile Subscriber Id. No
Parameter	*Value ranges*	Description of parameters	Def. value	Def. unit	Unit ring
MCC	**0 to 999**	Mobile Country Code	001	–	–
MNC	**0 to 99**	Mobile Network Code	01	–	
MSIN	**"0" to "9999999999"**	Mobile Subscriber Id. No.	"1000000095"	–	
Description of command				Status	FW vers.
This command defines an international mobile subscriber identity *(IMSI)* which serves as the default setting for a call to the mobile. It consists of the mobile country code (*MCC*), mobile network code (*MNC*) and the mobile subscriber identification no. (*MSIN*). MSIN is a string variable and must be entered within quotation marks (' or "). The values defined here can be overwritten by the mobile parameters. The default value quoted above for MSIN applies to phase II mobiles. The default value for phase I mobiles is "1000000000".				SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:SMODe:PCHange *<Mode>* Power Change Mode

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
FAST | **SLOW**	Fast power change Slow power change	FAST	–	–

Description of command	Status	FW vers.
This command determines the speed of power control on the mobile phone. The slow power change is controlled via SACCH *(slow associated control channel)*, the fast power change via FACCH *(fast associated control channel).*	SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:SMODe:SCHannel *<Channel>* Signalling Channel

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
SDCCh | **FACCh |** **NONE**	Signalling via *stand-alone dedicated control channel* Signalling via *fast associated control channel* No signalling	FACCH	–	–

Description of command	Status	FW vers.
This command determines the signalling channel.	SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:SMODe:TRAFfic *<Mode>* Traffic

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
FRV1 | **FRV2 |** **HRV1 |** **FD24 |** **FD48 |** **FD96 |** **FD14 |** **HD24 |** **HD48**	Full-rate coding, Full Rate Version 1 Full Rate Version 2 (Enhanced Full Rate) Half-rate coding, Half Rate Version 1 Full Rate Data 2400 Baud Full Rate Data 4800 Baud Full Rate Data 9600 Baud Full Rate Data 14400 Baud Half Rate Data 2400 Baud Half Rate Data 4800 Baud	FRV1	–	–

Description of command	Status	FW vers.
This command determines the speech coding and voice transmission in the traffic channels (full-rate channel, half-rate channel).	SOFF, SON, SYNC Q: all	≥1.15

CONFigure:NETWork:SMODe:LCOMmand *<Mode>* Loop Command

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ENABle | **DISable |** **BER**	The CMU sends "Close Loop" every time a call is established The CMU never sends „Close Loop" → Mobile never sends back Loop is closed for BER measurements only	BER	–	–

Description of command	Status	FW vers.
This command determines in which cases the open/close loop command is sent to the mobile. Closing of the loop causes the mobile to send back the bits received.	SOFF, SON SYNC Q: all	≥1.15

CONFigure:NETWork:SMODe:STIMe *<Mode>*				Starting Time
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 600 Frames | OFF	Starting time, number of frames transferred	0		–
Description of command			Status	FW vers.
The starting time is used with channel, timeslot and fast power change. The value 0 means that no start time is used.			SOFF, SON SYNC. Q: all	≥1.15

Subsystem NETWork:IDENtity

The subsystem *NETWork:IDENtity* defines the identity for the mobile radio network. The subsystem corresponds to the table field *Network Identity* in the popup menu *Network.*

CONFigure:NETWork:IDENtity:NCC <*Code*>				NCC
<Code>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 7	Color code of mobile network	0	–	–
Description of command			Status	FW vers.
This command defines the color code of the network *(NCC = network color)* for the signals of the measuring instrument.			SOFF, SON Q: all	≥1.15

CONFigure:NETWork:IDENtity:MCC <*Code*>				MCC
<Code>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 999	Mobile country code	001	–	–
Description of command			Status	FW vers.
This command defines the mobile country code.			SOFF, SON Q: all	V1.15

CONFigure:NETWork:IDENtity:MNC <*Code*>				MNC
<Code>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 99	Mobile network code	01	–	–
Description of command			Status	FW vers.
This command defines the mobile network code for the signals of the measuring instrument.			SOFF, SON Q: all	≥1.15

CONFigure:NETWork:IDENtity:BCC <*Code*>				BCC
<Code>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 7	Color code of measuring instrument	0	–	–
Description of command			Status	FW vers.
This command defines the color code of the BTS *(base transceiver station color code, BTS color code = BCC).*			SOFF, SON Q: all	≥1.15

CONFigure:NETWork:IDENtity:LAC <*Code*>				Location Area
<Code>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 65533 and 65535	Location area code	1	–	–
Description of command			Status	FW vers.
This command defines the location area code.			SOFF, SON Q: all	≥1.15

Subsystem NETWork:SYSTem (System Parameters)

The subsystem *NETWork:System* determines system parameters for the radio connection. The subsystem corresponds to the table field *System Parameters* in the popup menu *Network*.

CONFigure:NETWork:SYSTem:CACCess *<Mode>* Call Access

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
BARRed | **NBARred**	Radio cell disabled for all mobiles Radio cell accessible	NBARred	–	–

Description of command	Status	FW vers.
This command enables or disables the radio cell for mobiles.	SOFF, SON Q: all	≥1.15

CONFigure:NETWork:SYSTem:BSAGblksres *<Blocks>* Number of Reserved Blocks

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 7	Number of reserved blocks in the BCCH for access channel	0	–	–

Description of command	Status	FW vers.
This command determines the number of data blocks to be reserved for the granted access *(access grant channel = AGC)* within the BCCH *(basic services access grant blocks reserved).*	SON, SOFF SYNC Q: all	≥1.15

CONFigure:NETWork:SYSTem:BSPamfrms *<Frames>* Paging Request Interval

<Frames>	Description of parameters	Def. value	Def. unit	Unit ring
2 to 9	Interval between two paging requests	2		–

Description of command	Status	FW vers.
This command defines the interval between two paging requests in a multiframe in frames *(basic services paging blocks available per multiframe).*	SON, SOFF SYNC Q: all	≥1.15

CONFigure:NETWork:SYSTem:BSPReorg <MODE> Paging Reorganisation

<Frames>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Paging reorganization on/off	OFF	–	–

Description of command	Status	FW vers.
This command swithches the paging reorganization parameter on and off. In the *OFF* state, the mobile is prevented from switching to the idle mode.		≥V2.00

Subsystem NETWork:TIMeout

The subsystem *NETWork:TIMeout* defines timeouts for aborting an unused radio link or an unsuccessful call to the mobile. The subsystem corresponds to the table field *Timeouts* in the popup menu *Network*.

CONFigure:NETWork:TIMeout:RLINk[:MOBile] *<Time>* Radiolink Timeout Mobile

<Time>	Description of parameters	Def. value	Def. unit	Unit ring
4 to 64	Permissible number of missing SACCH blocks (the step size is 4)	24	–	–

Description of command	Status	FW vers.
This command defines the maximum number of SACCH blocks which may be missing before a **mobile phone** considers the radio link to be interrupted *(radio link timeout)*	SON, SOFF SYNC Q: all	≥1.15

CONFigure:NETWork:TIMeout:RLINk:TESTset *<Time>* Radiolink Timeout Testset

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
4 to 64 |	Permissible number of missing SACCH blocks (the step size is 1)	24		–
OFF	Monitoring of radio link is switched off (ie there is no Sync. Lost in the case of missing SACCH blocks)			

Description of command	Status	FW vers.
This command determines the maximum number of SACCH blocks which may be missing before the **CMU** considers the radio link to be interrupted *(radio link timeout for test set).*	SON, SOFF SYNC Q: all	≥1.15

CONFigure:NETWork:TIMeout:MTC *<Time>* MTC Timeout

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
0 s to 60 s	Time limit for call to mobile	10	s	TIME
OFF	No time limit (unlimited ringing)			

Description of command	Status	FW vers.
This command determines the maximum dialing time until the mobile accepts the call *(mobile terminated call timeout)*; after this time, the attempted call setup is aborted. In the setting OFF, ringing is possible for an unlimited period of time.	SON, SOFF SYNC Q: all	≥1.15

Subsystem IOConnector (External Attenuation at the Connectors)

The subsystem *IOConnector* contains the commands for configuration of the input and output connectors. The subsystem corresponds to the index card AF/RF ⊕, in the popup menu *Connect. Control.*

INPut[:STATe] *<State>* RF Input

<State>	Description of parameters	Def. value	Def. unit	Unit ring
RF1	Connector RF1 used as input	RF2	–	–
RF2	Connector RF2 used as input			
RF4	Connector RF4 IN used as input			

Description of command	Status	FW vers.
This command determines the connector to be used for incoming RF signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the very same measurement (see `OUTPut[:STATe]`). When changing to a different subsystem (other band or changing from Signalling to Non-Signalling), the connector settings of the new subsystem are activated.	all	≥1.15

OUTPut[:STATe] *<State>* RF Output

<State>	Description of parameters	Def. value	Def. unit	Unit ring
RF1	Connector RF1 used as output	RF2	–	–
RF2	Connector RF2 used as output			
RF3	Connector RF3 OUT used as output			

Description of command	Status	FW vers.
This command determines the connector to be used for outgoing RF signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the very same measurement. When changing to a different subsystem (other band or changing from Signalling to Non-Signalling), the connector settings of the new subsystem are activated.	all	≥1.15

[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] *<Attenuation >*
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] *<Attenuation >* Ext. Att. Input

<Attenuation>	Description of parameters	Def. value	Def. unit	Unit ring
–50 dB to +50 dB	Value for external attenuation at Input<nr>, where <nr> = 1,2,4	0	dB	Ratio

Description of command	Status	FW vers.
This command assigns an external attenuation value to one of the inputs defined before (see command `INPut:STATe).`	all	≥1.15

[SENSe:]CORRection:LOSS:Output<nr>[:MAGNitude] *<Attenuation>*
SOURce:CORRection:LOSS:Output<nr>[:MAGNitude] *<Attenuation>* Ext. Att. Output

<Attenuation>	Description of parameters	Def. value	Def. unit	Unit ring
–50 dB to +50 dB	Value for external attenuation at Output<nr>, where <nr> = 1,2,3	0	dB	Ratio

Description of command	Status	FW vers.
This command assigns an external attenuation value to one of the outputs defined before (see command `OUTPut:STATe`).	all	≥1.15

ROUTe:SPENcoder[:INPut] *<Source>* Speech Encoder

<Source>	Description of parameters	Def. value	Def. unit	Unit ring
HANDset |	Handset is used as source	HAND	–	–
GENerator |	AF generator is used as source			
AUX1	AUX1 connector is used as source			

Description of command	Status	FW vers.
This command determines the input source that feeds the CMU speech encoder (option CMU-B52).	all	V002 Audio

ROUTe:SPDecoder[:OUTPut] *<Destination>* Speech Decoder

<Destination>	Description of parameters	Def. value	Def. unit	Unit ring
HANDset |	Speech decoder output is routed to the handset	HAND	–	–
ANALyzer |	Speech decoder output is routed to the AF analyzer			
AUX2	Speech decoder output is routed to the AUX2 connector			

Description of command	Status	FW vers.
This command routes the CMU speech decoder output (option CMU-B52).	all	V002 Audio

Subsystem REFerence (Synchronization)

The subsystem *REFerence* contains the commands for setting the reference frequency. This frequency is set in the index card *Synch.* in the popup menu *Connect. Control.*

SOURce:DM:CLOCk:STATe *<Mode>* REF OUT 2 on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switching the reference frequency on/off	OFF	–	–

Description of command	Status	FW vers.
This command switches the reference frequency at output *REF OUT 2* on or off.	SOFF Q: all	≥1.15

SOURce:DM:CLOCk:FREQuency *<Frequency>* REF OUT 2

<Frequency>	Description of parameters	Def. value	Def. unit	Unit ring
1.2190 MHz to 39.000 MHz	Input value for reference frequency	13.000	MHz	

Description of command	Status	FW vers.
This command defines the reference frequency applied to output *REF OUT 2.* The frequency entered is rounded to one of the following discrete values: 39.000 MHz, 19.500 MHz, 13.000 MHz, 9.750 MHz, 7.800 MHz, 6.500 MHz, 5.571 MHz, 4.875 MHz, 4.333 MHz, 3.900 MHz, 3.545 MHz, 3.250 MHz, 3.000 MHz, 2.786 MHz, 2.600 MHz, 2.438 MHz, 2.294 MHz, 2.166 MHz, 2.053 MHz, 1.950 MHz, 1.857 MHz, 1.773 MHz, 1.696 MHz, 1.625 MHz, 1.560 MHz, 1.500 MHz, 1.444 MHz, 1.393 MHz, 1.349 MHz, 1.300 MHz, 1.258 MHz, 1.219 MHz	SOFF Q: all	≥1.15

Pseudo Test Object RREPorts

The subsystem *RREPorts* contains the commands for requesting the receiver report of the mobile. Together with *NETWork[:MS]* the subsystem corresponds to the softkey *MS Rcv. Reports* in the main menu *GSM900-MS Overview.* The receiver characteristics do not really represent a measured value, since the values are automatically transmitted during signalling.

[SENSe:]RREPorts:RXLevel?				RX Level
Return	Description of parameters	Def. value	Def. unit	Unit ring
0 to 63	Receiver level on mobile phone	NAN	–	
Description of command			Status	FW vers.
This command is always a query. It outputs the receiver level that the mobile reports to the CMU, expressed in levels without dimension (see chapter 4).			CEST	≥1.15

[SENSe:]RREPorts:RXQuality?				RX Quality
Return	Description of parameters	Def. value	Def. unit	Unit ring
0 to 7	Received-signal quality on mobile	NAN	–	
Description of command			Status	FW vers.
This command is always a query. It outputs the received signal quality that the mobile reports to the CMU, expressed in quality levels without dimension (see chapter 4).			CEST	≥1.15

[SENSe:]RREPorts:NCELl?				RX Level in Neighbor Cells
Return	Description of parameters	Def. value	Def. unit	Unit ring
0 to 124 | 955 to 1023, **0 to 63 | NAN**	Channel numbers of the 6 neighbor cells RX Level in neighbor cells	NAN, NAN	–	
Description of command			Status	FW vers.
This command is always a query. It returns the channel number and the signal level for six neighbor channels (see command `[SENSe:]RREPorts:RXLevel` and chapter 4). The output list consists of 6 pairs of channels and corresponding RX Levels, separated by commas. The channel numbers depend on the GSM band (the quoted parameter list refers to GSM900), see chapter 4.			CEST	≥1.15

[SENSe:]RREPorts:DTX?				DTX
Return	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Mobile phone transmits with interruption Mobile phone transmits without interruption	NAN	–	–
Description of command			Status	FW vers.
This command is always a query and returns the DTX mode *(discontinuous transmission mode)* currently used by the mobile phone.			CEST	≥1.15

[SENSe:]RREPorts:COUNt?				Number of Measurement Reports
Return	Description of parameters	Def. value	Def. unit	Unit ring
0 to n	Number of measurement reports received	0	–	–
Description of command			Status	FW vers.
This command is always a query and returns the number of receiver reports transmitted since the call was established. According to GSM specifications, a receiver report is transmitted every 4 multiframes.			CEST	≥2.0

Pseudo Test Object MSSinfo
(Signalling information of mobile phone)

The subsystem *MSSinfo* contains the commands for requesting the signalling characteristics of the mobile. The subsystem corresponds to the *Signalling Info* output table in the main menu *GSM900-MS Overview.* The signalling characteristics do not actually represent a measured value, the values being provided by the mobile phone during the signalling process.

[SENSe:]MSSinfo:IMSI:MNC? <*MNC*> MNC
[SENSe:]MSSinfo:IMSI:MCC? <*MCC*> MCC
[SENSe:]MSSinfo:IMSI:MSIN? <*MSIN*> MSIN

Parameter	*Value ranges*	Description of parameters	Def. value	Def. unit	Unit ring
MCC	**0 to 999**	Mobile Country Code	NAN	–	–
MNC	**0 to 99**	Mobile Network Code	NAN	–	
MSIN	**"0" to "9999999999"**	Mobile Subscriber Id. No.	"" (empty string)	–	

Description of command	Status	FW vers.
These commands are always queries and read the international mobile subscriber identification code (IMSI) of the mobile. It consists of the mobile country code (*MCC)*, the mobile network code (*MNC)* and the mobile subscriber identification no. (*MSIN)*.	SYNC CEST	≥1.15

[SENSe:]MSSinfo:IMEI:FAC <*FAC*> Intern. mobile station equipment id.: FAC
[SENSe:]MSSinfo:IMEI:TAC? <*TAC*> TAC
[SENSe:]MSSinfo:IMEI:SNR? <*SNR*> SNR
[SENSe:]MSSinfo:IMEI:SVN? <*SVN*> SVN

Parameter	*Value ranges*	Description of parameters	Def. value	Def. unit	Unit ring
TAC	**6-digit**	Type approval code	NAN	–	–
FAC	**2-digit**	Final assembly code	NAN	–	
SNR	**6-digit**	Serial number	NAN	–	
SVN	**1 | 2-digit**	Software version number	NAN	–	

Description of command	Status	FW vers.
These commands are always queries and read the international mobile station equipment identity (IMEI) of the mobile phone. It consists of a type approval code (*TCC)*, the final assembly code (*FAC*), the serial number (*SNR*) and the software version number (*SVR*).	SYNC CEST	≥1.15

[SENSe:]MSSinfo:REVision? MS Rev. Level

Return	Description of parameters	Def. value	Def. unit	Unit ring
PH1 |	Phase 1	NAN	–	–
PH2 |	Phase 2			
PH2P	Phase 2+			

Description of command	Status	FW vers.
This command is always a query and reads the output (GSM phase) of the mobile.	SYNC CEST	≥1.15

[SENSe:]MSSinfo:DNUMber?				Dialled Number
Return	Description of parameters	Def. value	Def. unit	Unit ring
Max. 20-digit	Dialed number	NAN	–	–
Description of command			Status	FW vers.
This command is always a query and reads the dialed number if a call is made to the mobile.			CEST	≥1.15

[SENSe:]MSSinfo:TRAFfic?				Traffic Mode
Return	Description of parameters	Def. value	Def. unit	Unit ring
FRV1 |	Full-rate coding, Full Rate Version 1	NAN	–	–
FRV2 |	Full Rate Version 2 (Enhanced Full Rate)			
HRV1 |	Half-rate coding, Half Rate Version 1			
FD24 |	Full Rate Data 2400 Baud			
FD48 |	Full Rate Data 4800 Baud			
FD96 |	Full Rate Data 9600 Baud			
FD14 |	Full Rate Data 14400 Baud			
HD24 |	Half Rate Data 2400 Baud			
HD48	Half Rate Data 4800 Baud			
Description of command			Status	FW vers.
This command is always a query and reads the speech coding and transfer in the traffic channel (full-rate channel, half-rate channel, full-rate channel with variable transfer rate).			CEST	≥1.15

[SENSe:]MSSinfo:POWer:CLASs?				Power Class
Return	Description of parameters	Def. value	Def. unit	Unit ring
1 to 5	Power class of mobile	NAN	–	–
Description of command			Status	FW vers.
This command is always a query and reads the power class of the mobile.			SYNC CEST	≥1.15

Test Object SPOWer (Wide Band Power)

The subsystem *SPOWer* contains the commands for measuring the power of the signal sent by the mobile phone. It corresponds to the softkey *Power* of the index card *Signalling* in the menu group *Connect. Control.*

INITiate:SPOWer	Start new measurement	*RUN*
ABORt:SPOWer	Abort running measurement and switch off	*OFF*
STOP:SPOWer	Stop measurement after current stat. cycle	*STOP*
CONTinue:SPOWer	Next measurement step (only *stepping mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status given in the top right column.	all	V1.15

CONFigure:SPOWer:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).	all	≥1.17

FETCh:SPOWer:STATus? Measurement Status

Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE,	No counting mode set	NONE	–	–

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	all	≥1.15

CONFigure:SPOWer:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>* Test cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous |	Continuous measurement (until `STOP` or `ABORT`)	SING	–	–
SINGleshot |	Single shot measurement (until `Status = RDY`)			
1 to 10000	Multiple measurement (*counting*, until `Status = STEP | RDY`)			

<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror |	Start measurement in case of error *(stop on error)*	NONE	–	–
NONE	Continue measurement even in case of error			

<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP |	Interrupt measurement after each statistics cycle	NONE	–	–
NONE	Continue measurement according to its rep. mode			

Description of command	Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always aborted after a single shot.*	all	≥1.15

READ[:SCALar]:SPOWer[:RESult]?	Start single shot measurement and return results
FETCh[:SCALar]:SPOWer[:RESult]?	Read out measurement results (unsynchronized)
SAMPle[:SCALar]:SPOWer[:RESults]?	Read out measurement results (synchronized)

Return	Description of parameters	Def. value	Def. unit	Unit ring
–30.0 dBm to +30.0 dBm	Maximum burst power (not averaged)	NAN	dBm	

Description of command	Status	FW vers.
These commands are always queries. They start the measurement of the maximum burst power of the signals sent by the mobile *(peak burst power)* and output the result.	all	≥1.15

Test Object POWer

The subsystem *POWer* measures the MS output carrier power versus time. The subsystem corresponds to the measurement menu *Power* and the associated popup menu *Power Configuration.*

Control of Measurement – Subsystem Power

The subsystem *POWer* controls the power measurement.

INITiate:POWer[:NORMal][:GMSK]	Start new measurement	*RUN*
ABORt:POWer[:NORMal][:GMSK]	Abort measurement and switch off	*OFF*
STOP:POWer[:NORMal][:GMSK]	Stop measurement after current stat. cycle	*STOP*
CONTinue:POWer[:NORMal][:GMSK]	Next meas. step (only *stepping mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status indicated in the top right column.	all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	–

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).	all	≥1.15

FETCh:POWer[:NORMal][:GMSK]:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	–
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	–
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	–

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	all	≥1.15

Subsystem POWer:CONTrol

The subsystem *POWer:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Statistics* tabs in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:CONTrol *<Mode>,<Statistics>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **OFF**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	–
Description of command			Status	FW vers.
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. ***Note:*** *The settings performed using this command have an effect on the modulation measurement!*			all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	≥1.15

DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID *<Enable>*				Grid
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	–
Description of command			Status	FW vers.
This command switches the grid lines in the test diagrams on or off.			all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault		Default Settings		
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*			all	2.0

Test Configuration

The commands of the following subsystems determine the parameters of the signal power measurement. They correspond to the *Power Configuration* popup menu. For a detailed explanation of the power tolerance template defined in the GSM standard see chapter 4.

Subsystem POWer:LIMIt:LINE

The subsystem *POWer:LIMit:LINE* defines the limit lines and thus the tolerance values for the power measurement. The subsystem corresponds to the index card *Limit Lines* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic] ***Parameters for query:*** ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>,*** ***<StartAbsLevel>, <EndAbsLevel>,<StartVisib.>,<EndVisib.>*** ***for setting:*** ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>,*** ***<StartAbsLevel>, <EndAbsLevel>, <Visibility>*** **CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]:ENABle *<Enable>***			Upper Limit Line
Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Defined section on/off	See below
<StartTime>,	-100 µs .. +700 µs |OFF (-50..160Bit),	Start point of time	See below
<EndTime>,	–100 µs .. +700 µs | OFF,	End point of time	
<StartRelLevel>,	–100 dB .. 10 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB .. 10 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm .. 30 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm .. 30.0 dBm | OFF,	End point of level (absolute)	
<Visibility> *<StartVisib.>* *<EndVisib>*	ON | OFF	Range of limit lines on/off	
Description of command		Status	FW vers.
These commands activate and define upper limit lines for normal bursts. The limit lines are defined section by section; the suffix <nr> numbers the various ranges of the limit lines.		all	≥1.15

8 ranges of limit lines are defined in the default setting, another 8 ranges can be activated if required. The default settings can be obtained from the following table:

	ForEnable	for Table						
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	–38.0µs	–28.0µs	–59.0dB	–59.0dB	–54.0dBm	–54.0dBm	ON
2	ON	–28.0µs	–18.0µs	–30.0dB	–30.0dB	–17.0dBm	–17.0dBm	ON
3	ON	–18.0µs	–10.0µs	–6.0 dB	–6.0dB	OFF	OFF	ON
4	ON	–10.0µs	0.0µs	+4.0dB	+4.0dB	OFF	OFF	ON
5	ON	0.0µs	552.8µs	+1.0dB	+1.0dB	OFF	OFF	ON
6	ON	552.8µs	560.8µs	–6.0dB	–6.0dB	OFF	OFF	ON
7	ON	560.8µs	570.8µs	–30.0dB	–30.0dB	–17.0dBm	–17.0dBm	ON
8	ON	570.8µs	600.0µs	–59.0dB	–59.0dB	–54.0dBm	–54.0dBm	ON
9	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

The setting *Visibility = Off* implies that the corresponding range, including the limit check, is switched off. The setting *Enable = Off* switches off the entire limit check.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]

Lower Limit Line

<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, E: <Visibility> A: <StartVisib.> <EndVisib.>

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic][:ENABle] ***<Enable>***

Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Definition section on/off	See below
<StartTime>,	-100 µs .. +700 µs |OFF (-50..160Bit),	Start point of time	see below
<EndTime>,	–100 µs .. +700 µs | OFF,	End point of time	
<StartRelLevel>,	–100 dB .. 10 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB .. 10 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm .. 30 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm .. 30.0 dBm | OFF,	End point of level (absolute)	
<Visibility>	ON | OFF	Range of limit lines on/off	
<StartVisib.>			
<EndVisib>			

Description of command	Status	FW vers.
These commands activate and define lower limit lines for normal bursts. The limit lines are defined section by section; the suffix <nr> numbers the different ranges of limit lines.	all	≥1.15

Only 1 range is defined in the default setting; another 15 ranges can be activated if required. The default settings will be given in the following table:

	forEnable	for table						
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	0.0µs	0.0µs	–100.0dB	–1.0dB	OFF	OFF	ON
2	ON	0.0µs	542.8µs	–1.0dB	–1.0dB	OFF	OFF	ON
3	ON	542.8µs	542.8µs	–1.0dB	–100.0dB	OFF	OFF	ON
4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]:MODE *<Mode>*

Upper Limit Line on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch on upper limit lines Switch off upper limit lines	ON	–	–

Description of command	Status	FW vers.
This command switches the upper limit lines for the active burst type (normal burst) and section <nr> on or off.	all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer[:STATic]:MODE *<Mode>*

Lower Limit Line on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch on lower limit lines Switch off lower limit lines	ON	–	–

Description of command	Status	FW vers.
This command switches the lower limit lines for the active burst type (normal burst) on or off.	all	≥1.15

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE[:UPPer]<AreaNr>:DYNamic<RangeNr>
<fromPCL>, <toPCL>, <Correction>, <Enable>

Dynamic Correction

<fromPCL>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 31 | MAX | OFF	First PCL for which area <AreaNr> is changed	See table below	PCL	
<toPCL>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 31 | MAX | OFF	Last PCL for which area <AreaNr> is changed.	See table below	PCL	
<Correction>	Description of parameters	Def. value	Def. unit	Unit ring
-10 dB to +10 dB | OFF	Correction value (relative) for the limit line in area <AreaNr> applied for all PCLs between <fromPCL> and <toPCL> (including)	See table below	dB	
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Enable or disable dynamic correction in the current limit line area and PCL range	See table below	–	–

Description of command	Status	FW vers.
These command activates and defines dynamic correction of the upper limit line of area <AreaNr> depending on the PCL range <RangeNr>.	all	

AreaNr = 1 to 16 RangeNr = 1 to 10

Range	fromPCL	toPCL	Correction	Enable
1	MAX	MAX	0.0 dB	OFF
2	0	16	0.0 dB	OFF
3	17	17	+ 2.0 dB	ON
4	18	19	+ 2.0 dB	ON
5	OFF	OFF	0.0 dB	OFF
6	OFF	OFF	0.0 dB	OFF
7	OFF	OFF	0.0 dB	OFF
8	OFF	OFF	0.0 dB	OFF
9	OFF	OFF	0.0 dB	OFF
10	OFF	OFF	0.0 dB	OFF

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE[:UPPer]<nr>:DYNamic:ENABle *<Enable>*

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch dynamic correction on or off	ON	–	–

Description of command	Status	FW vers.
This command switches the dynamic correction of the upper limit area <nr> for all ten PCL ranges on or off.	all	2.0

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE[:UPPer]:ALL:DYNamic:ENABle *<Enable>*

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch dynamic correction for the whole template on or off	ON	–	–

Description of command	Status	FW vers.
This command switches the dynamic correction of the upper limit line in all areas and for all PCL ranges on or off.	all	2.0

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<AreaNr>:DYNamic<RangeNr>
<fromPCL>, <toPCL>, <Correction>, <Enable>

Dynamic Correction

<fromPCL>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 31 | MAX | OFF	First PCL for which area <AreaNr> is changed	OFF	PCL	FG Power Level
<toPCL>	Description of parameters	Def. value	Def. unit	Unit ring
0 to 31 | MAX | OFF	Last PCL for which area <AreaNr> is changed.	OFF	PCL	FG Power Level
<Correction>	Description of parameters	Def. value	Def. unit	Unit ring
-10 dB to +10 dB | OFF	Correction value (relative) for the limit line in area <AreaNr> applied for all PCLs between <fromPCL> and <toPCL> (including)	OFF	dB	
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Enable or disable dynamic correction in the current limit line area and PCL range	OFF	–	–

Description of command	Status	FW vers.
These command activates and defines dynamic correction of the lower limit line of area <AreaNr> depending on the PCL range <RangeNr>. AreaNr = 1 to 16 RangeNr = 1 to 10	all	

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>:DYNamic:ENABle *<Enable>*

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch dynamic correction on or off	OFF	–	–

Description of command	Status	FW vers.
This command switches the dynamic correction of the lower limit area <nr> for all ten PCL ranges on or off.	all	2.0

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer:ALL:DYNamic:ENABle ***<Enable>***

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | OFF	Switch dynamic correction for the whole template on or off	OFF	–	–

Description of command	Status	FW vers.
This command switches the dynamic correction of the lower limit line in all areas and for all PCL ranges on or off.	all	2.0

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault

Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	the parameters are set to their default values the parameters differ from the default values (partially or totally)	ON	–	–

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	all	≥1.15

Subsystem POWer:LIMIt:ABPower

The subsystem *POWer:LIMit:ABPower* defines the limit values for the average burst power. The subsystem corresponds to the index card *Limits* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr> ***<StartPCL>, <StopPCL>, <LowerLimit>, <UpperLimit>***

Average Burst Power

CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr>[:ENABle] ***<Enable>***

Parameter	Value range	Description of parameters	Def. value
<Enable>	**ON | OFF**	Definition section on/off	see below
<StartPCL>,	**0 to 31 | MAX**	Start value for PCL	see below
<EndPCL>,	**0 to 31 | MAX**	End value for PCL	
<LowerLimit>,	**–10.0 dB to 0.0 dB**	Lower level limit	
<UpperLimit>	**0.0 dB to +10.0 dB**	Upper level limit	

Description of command	Status	FW vers.
These commands determine the tolerances for ranges of power control levels (PCLs). <nr> is the number of the group ($<nr> \in \{1,...,10\}$) The setting *MAX* is synonymous with the highest PCL of the mobile, depending on its power class.	all	≥1.15

4 level ranges are defined in the default setting, another 6 ranges can be activated if required. The default settings for GSM 900/1800/1900 will be given in the following table:

	forEnable	for table			
Suffix	Enable	StartPCL	StopPCL	LowerLimit	UpperLimit
1	ON	MAX	MAX	–2.0 dB	+2.0 dB
2	ON	0	2/8/8	–2.0/–3/–3 dB	+2.0/3/3 dB
3	ON	3/9/13	15/13/13	–3.0/–4/-4 dB	+3.0/4/4 dB
4	ON	16/14/28	31/14/29	–5.0 dB	+5.0 dB
5	OFF	OFF	OFF	OFF	OFF
10	OFF	OFF	OFF	OFF	OFF

Subsystem POWer:TIME

The subsystem *POWer:TIME* contains the command for shifting the time axis (and thus the tolerance mask). The subsystem corresponds to the popup window *Time - Mode* in the graphical measurement menu *Power.*

CONFigure:POWer[:NORMal][:GMSK]:TIME:MODE *<Mode>*				Mode
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
GSM | OFFSet	Positioning according to GSM Fixed ½-bit time offset	GSM	–	–
Description of command			Status	FW vers.
This command determines a time interval by which the burst is shifted with respect to the time axis and the tolerance mask.			all	≥1.15

Subsystem SUBarrays:POWer

The subsystem *SUBarrays:POWer* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK] <Mode>,<Range>{, <Range>}				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>.	Description of parameters	Def. value	Def. unit	Unit ring
–100 µs to 700 µs, **0 to 668**	Start time in current range Number of samples in current range	NAN NAN	µs –	
Description of command			Status	FW vers.
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`,, and `SAMPle:SUBarrays:POWer` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. The subranges may overlap but must be within the total range of the *power vs time* measurement. If the combination of start time and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.			all	2.0

Measured Values

The commands of the following subsystems determine and return the results of the signal power measurement. They correspond to the graphical menu *Power* with its various display elements.

Subsystem POWer[:RESult]

The subsystem *POWer[:RESULT]* contains the commands for measurement and output of the burst power and its comparison with tolerance values. The subsystem corresponds to the graphical measurement menu *Power.*

Scalar results:

READ[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?
Start single shot measurement and return results

FETCh[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?
Read out measurement results (unsynchronized)

SAMPle[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?
Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
PeakBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
PowerControlLevel,	0 to 32 (dep. on network, see chap. 4)	NAN	PCL	
TimingAdvError,	-100.0 Bit to +100.0 Bit	NAN	Bit	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
BurstMatching	MATC | NMAT | INV | NTSC | OUT	INV	–	
AvgBurstPwAvg	–100.0 dBm to +20.0 dBm	NAN	dBm	

Description of command	Status	FW vers.
These commands are always queries.	all	≥1.15

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the results without taking care of the measurement state.
- `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The results are:

Average burst power (current burst)
Peak burst power (current burst)
Power control level
Timing advance error
Burst out of tolerance
Burst template matching
Average burst power of average trace

The following messages may be output for the value *BurstMatching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of tolerance*

CALCulate[:SCALar]:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing? Limit Matching

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	–
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
TimingAdvError,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching	MATC | NMAT | INV | NTSC | OUT	INV	–	
AvgBurstPwAvg	NMAU | NMAL | INV | OK	INV	–	

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see command above) have been exceeded.	all	≥1.15

The following messages may be output for the values *AvgBurstPowerCurr, PeakBurstPowerCurr, AvgBurstPowerAvg,* and *TimingAdvError*.

OK	Tolerance value matched	*OK.*
NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measured value invalid	*invalid*

The following messages may be output for the value *BurstMatching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of tolerance*

READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]? Burst Power
READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Start single shot measurement and return results
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read measurement results (unsynchronized)
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	FG Power Level
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the different power values of the bursts in a fixed ¼-bit pattern. The number of measured values is max. 669 samples.	all	≥1.15

The calculation of *current, average, maximum* and *minimum* values is explained in chapter 3 (cf. *display mode*).

READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]? Subarray Results
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Start measurement and wait for end *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:POWer` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned by subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MINimum?
Burst Matching

Returned values	Value range	Def. value	Def. unit	Unit ring
Matching	MATC | NMAT | INV | NTSC | OUT	INV	–	–

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way permissible tolerances for the burst power (see command above) have been exceeded. The following messages may be output for the value *Matching*: MATC *matching* NMAT *not matching* INV *invalid* NTSC *no training sequence code* OUT *out of tolerance*	all	≥1.15

CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MINimum?

Range Violation

Returned value	Description of parameters	Def. value	Def. unit	Unit ring
32 bit field,	Indicator for upper limit matching in area 1 to 16	NAN	–	–
32 bit field	Indicator for lower limit matching in area 1 to 16	NAN	–	–

Description of command	Status	FW vers.
This command is always a query. Any set bit of the two returned fields indicates the violation of the corresponding section of the limit lines.	all	1.20

Subsystem POWer:PCL

The subsystem *POWer:PCL* controls the power vs PCL measurement. It corresponds to the measurement menu *Power* with the application *P/PCL*:

INITiate:POWer:PCL	Start new measurement	*RUN*
ABORt:POWer:PCL	Abort running measurement and switch off	*OFF*
STOP:POWer:PCL	Stop measurement after current stat. cycle	*STOP*
CONTinue:POWer:PCL	Next measurement step (only *stepping mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status indicated in the top right column.	all	V2.0

CONFigure:POWer:PCL:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).	all	V2.0

FETCh[:SCALar]:POWer:PCL:STATus? Measurement Status

Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	–

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	all	V2.0

Subsystem POWer:PCL:CONTrol

CONFigure:POWer:PCL:CONTrol:REPetition *<Repetition>,<StopCondition>,<Stepmode>* Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous |	Continuous measurement (*continuous*, until STOP or ABORT)	SING	–	–
SINGleshot |	Single measurement (*single shot*, until Status = RDY)			
1 to 10000	Multiple measurement (*counting*, until Status = STEP | RDY)			
<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command determines the number of statistics cycles and the stepping mode for the measurement. **Note:** *In the case of READ commands (READ:...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			All	V2.0

Subsystem POWer:PCL:CHANnel

The subsystem *POWer:PCL:CHANnel* defines three channels for the *P/PCL* measurement. The subsystem corresponds to the *Channel* softkey in the measurement menu *P/PCL.*

CONFigure:POWer:PCL:CHANnel <Channel1>,<Channel2>,<Channel3> Channel

Channel<nr>	Value range	Def. value: Cannel 1,2,3	Def. unit	Unit ring
GSM900	0 to 124; 955 to 1023	1,62,124	–	–
GSM1800	512 to 885	512, 698, 885		
GSM1900	512 to 810	512, 661, 810		
Description of command			Status	FW vers.
This command defines three GSM channel numbers for the P/PCL measurement.			All	V2.0

Subsystem POWer:PCL[:RESult]

The subsystem *POWer:PCL[:RESULT]* contains the commands for measurement and output of the power versus PCL application for three selected channels. The subsystem corresponds to the measurement menu *P/PCL.*

	Scalar Results:
READ[:SCALar]:POWer:PCL[:RESult]	Start single shot measurement and return results
FETCh[:SCALar]:POWer:PCL[:RESult]?	Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:PCL[:RESult]?	Read out measurement results (synchronized)

Return	Value range	Def. value	Def. unit	Unit ring
PCL1, P1Ch1,	**GSM900:**			
P1Ch2, P1Ch3,	PCL: 0 to 31	NAN	–	
	Power: 5.0 dBm to +39.0 dBm	NAN	dBm	
... ,	**GSM1800:**			
	PCL: 0 to 31	NAN		
PCLn, PnCh1,	Power: 0.0 dBm to +36.0 dBm	NAN	dBm	
PnCh2,PnCh3	**GSM1900:**			
	PCL: 0 to 31	NAN		
	Power: 0.0 dBm to +33.0 dBm	NAN	dBm	

Description of command	Status	FW vers.
These commands are always queries. They start a measurement and return all measurement results. The returned list contains all possible PCLs of the mobile phone together with the measured MS output powers in the three selected channels. The output values are: PCL1 to PCLn *PCLs of the mobile* PxChy *Average burst power for PCL = x and channel = y* The PCL range depends on the GSM phase and the power class of the mobile. For a list of possible PCLs and nominal maximum output power of the mobiles refer to chapter 4.	All	V2.0

CALCulate[:SCALar]:POWer:PCL[:RESult]:LIMit:MATChing?		Results of Limit Check		
Returned values	Description of parameters	Def. value	Def. unit	Unit ring
Matching	OK | NMAU | NMAL | INV	INV	–	–

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible tolerances for the burst power (see preceding command) are exceeded. The following messages may be output for the measured value *Matching*: OK Tolerance value matched *OK.* NMAU Underflow of tolerance value *not matching, underflow* NMAL Tolerance value exceeded *not matching, overflow* INV Measured value invalid *invalid* The complete output list reports the limit matching for all measured PCLs and the three channels defined via `CONFigure:POWer:PCL:CHANnel`, starting with the three channels for the first PCL, e.g. 1, OK, OK, OK, 2, OK, OK, OK, 3, OK, OK, OK, ...	all	V2.0

Test Object POWer:MPR

The subsystem *POWer:MPR* combines the *POWer* and *MODulation* systems, i.e. it measures the signal power vs. time and the scalar modulation parameters simultaneously. The subsystem contains all commands for measurement control and for the output of measurement results; configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

The *POWER:MPR* has no equivalent in manual control where the power and modulation measurement results are displayed separately.

Control of measurement – Subsystem Power:MPR

The subsystem *POWer:MPR* controls the combined power and modulation measurement.

INITiate:POWer[:NORMal][:GMSK]:MPR	Start new measurement	*RUN*
ABORt:POWer[:NORMal][:GMSK]:MPR	Abort running measurement and switch off	*OFF*
STOP:POWer[:NORMal][:GMSK]:MPR	Stop measurement after current stat. cycle	*STOP*
CONTinue:POWer[:NORMal][:GMSK]:MPR	Next meas. step (only *stepping mode*)	*RUN*
Description of command	Status	FW vers.
These commands do not exist as queries. They start and stop the combined power and modulation measurement, setting it to the status indicated in the top right column.	all	2.0

CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	–
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).			all	2.0

FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	–
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	–
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	2.0

Subsystem POWer:MPR:CONTrol

The subsystem *POWer:MPR:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement.

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol *<Mode>, <Statistics>*

Scope of Measurement

<Mode>	Desciption of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	–
Description of command			Status	FW-Vers.
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.			all	2.0

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*

Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCond>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	2.0

Test Configuration

The commands of the following subsystems configure the combined power and modulation measurement. Note that configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

Subsystem SUBarrays:POWer:MPR

The subsystem *SUBarrays:POWer:MPR* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR <Mode>,<Range>{,<Range>}

Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL |	Return all measurement values	ALL	–	–
ARIThmetical |	Return arithm. mean value in every range			
MINimum |	Return minimum value in every range			
MAXimum,	Return maximum value in every range			
<Range>.	Description of parameters	Def. value	Def. unit	Unit ring
–100 µs to 700 µs,	Start time in current range	NAN	µs	–
0 to 668	Number of samples in current range	NAN	–	

Description of command	Status	FW vers.
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:MPR` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. The subranges may overlap but must be within the total range of the *power vs time* measurement. If the combination of start time and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.	all	2.0

Measured Values – Subsystem POWer:MPR[:RESult]

The subsystem *POWer:MPR[:RESULT]* determines and outputs the results of the combined power and modulation measurement.

READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]? Scalar Results:
Start single shot measurement and return results
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?
Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?
Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
PeakBurstPwCurr,	–100.0 dBm to +20.0 dBm	NAN	dBm	
PowerControlLevel,	0 to 32 (dep. on network, power class...)	NAN	PCL	
TimingAdvError,	–100.0 Bit to +100.0 Bit	NAN	Bit	
BurstsOutOfTol,	0.0% too 100.0%	NAN	%	
BurstMatching,	MATC | NMAT | INV | NTSC | OUT	INV	–	
PhErrPeakCurrent,	–100.0 °to +100.0 °	NAN	deg	
PhErrPeakAverage,	–100.0 °to +100.0 °	NAN	deg	
PhErrPeakMaxMin,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSCurrent,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSAverage,	–100.0 °to +100.0 °	NAN	deg	
PhErrRMSMaxMin,	–100.0 °to +100.0 °	NAN	deg	
FreqErrCurrent,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrAverage,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrMaxMin,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
AvgBurstPwAvg	–100.0 dBm to +20.0 dBm	INV	dBm	

Description of command	Status	FW vers.
These commands are always queries. They start a combined power vs. time and modulation measurement and output all scalar measurement results. For detailed information refer to the description of the analogous commands in the POWer and MODulation systems.	all	2.0

READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]? Traces
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Start measurement and wait for end *RUN*
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit. The calculation of *current, average, minimum* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]? Subarray Results
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Start measurement and wait for end *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

CALCulate:POWer[:NORMal][:GMSK]:MPR[:RESult]:LIMit:MATChing? Limit Matching

Returned values	Value range	Def. value	Def. unit	Unit ring
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching,	MATC | NMAT | INV | NTSC | OUT	INV	–	
PhErrPeakCurrent,	For all measured values: NMAU |NMAL | INV | OK	INV	–	–
PhErrPeakAverage,		INV	–	
PhErrPeakMaxMin,		INV	–	
PhErrRMSCurrent,		INV	–	
PhErrRMSAverage,		INV	–	
PhErrRMSMaxMin,		INV	–	
FreqErrCurrent,		INV	–	
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPwAvg		INV	–	

Description of command	Status	FW vers.
		2.0

This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar resultss (see command above) in the *power vs time* and the *modulation* measurement have been exceeded.

The following messages may be output for the values A*vgBurstPower (current or average)* and *PeakBurstPower* and for all results of the modulation measurement:

NMAU	Tolerance value underflow	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	Tolerance value matched	

The following messages may be output for the value *BurstMatching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of range*

Test Object MODulation

The subsystem *MODulation* measures the modulation parameters, i.e. the frequency and phase error of the measured bursts. The subsystem corresponds to the measurement menu *Phase/Frequency* and the associated popup menu *Phase/Freq. Error Config.*

Control of Measurement – Subsystem MODulation

The subsystem *MODulation* controls the modulation measurement. It corresponds to the softkey *Phase/Freq.* in the measurement menu *Phase/Frequency*.

INITiate:MODulation	Start new measurement	*RUN*
ABORt:MODulation	Abort running measurement and switch off	*OFF*
STOP:MODulation	Stop measurement after current stat. cycle	*STOP*
CONTinue:MODulation	Next measurement step (only *stepping mode*)	*RUN*
Description of command	Status	FW vers.
These commands do not exist as queries. They start and stop the modulation measurement, setting it to the status indicated in the top right column.	all	≥1.15

CONFigure: MODulation:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).			all	≥1.15

FETCh:MODulation:STATus? Measurement Status

Ret. values	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE,	No counting mode set	NONE	–	–
1 to 1000 |	Counter for current evaluation period within a cycle			
NONE	Statistic count set to off	NONE	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	≥1.15

Subsystem MODulation:CONTrol

The subsystem *MODulation:CONTrol* contains the commands for configuration of the modulation measurement. It corresponds to the index cards *Control* and *Statistics* in the popup menu *Phase/Freq. Error Config.*

CONFigure:MODulation:CONTrol *<Mode>, <Statistics>*

Scope of Measurement

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar |	Only scalar measured values (incl. tolerance matching)	ARRay	–	–
ARRay	Scalar measured values and arrays			
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 |	Bursts per statistics cycle	100	–	–
OFF	Statistics off			
Description of command			Status	FW vers.
This command restricts the type of measured value and determines the number of bursts constituting a statistics cycle. **Note:** *The settings performed using this command have an effect on the power measurement!*			all	≥1.15

CONFigure:MODulation:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>*

Test cycles

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous |	Continuous measurement (until `STOP` or `ABORT`)	SING	–	–
SINGleshot |	Single shot measurement (until `Status = RDY`)			
1 to 10000	Multiple measurement (*counting*, until `Status = STEP | RDY`)			
<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror |	Stop measurement in case of error *(stop on error)*	NONE	–	–
NONE	Continue measurement even in case of error			
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP |	Interrupt measurement after each statistics cycle	NONE	–	–
NONE	Continue measurement according to its rep. mode			
Description of command			Status	FW vers.
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	≥1.15

CONFigure:MODulation:CONTrol:DEFault *<Mode>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.			all	

Test Configuration – Subsystem MODulation:LIMit

The subsystem *MODulation:LIMit* defines tolerance values for the modulation measurement. The subsystem corresponds to the index card *Limits* in the popup menu *Modulation.*

CONFigure:MODulation:LIMit:[:CURRent] *<PhaseErrorPeak>, <PhaseErrorRMS>,<FrequencyError>*				Upper Phase/Freq. Errors
Parameter	Description of parameters	Def. value	Def. unit	Unit ring
0.0 to +50.0 deg	PhaseErrorPeak, limit for max. phase error	+20.0	deg	
0.0 to +50.0 deg	PhaseErrorRMS, limit for RMS phase error	+5.0	deg	
0.0 to. +1000 Hz	FrequencyError, limit for frequency error	+90	Hz	
Description of command			Status	FW vers.
This command defines the upper limits for the peak and RMS phase error as well as for the frequency error in the current burst. The default frequency error is 90 Hz for GSM900, 180 Hz for GSM1800/1900.			all	≥1.15

CONFigure:MODulation:LIMit:AVERage *<PhaseErrorPeak>, <PhaseErrorRMS>,<FrequencyError>*				Average Limits
Parameter	Description of parameters	Def. value	Def. unit	Unit ring
0.0 to +50.0 deg	PhaseErrorPeak, limit for max. phase error	+20.0	deg	
0.0 to +50.0 deg	PhaseErrorRMS, limit for RMS phase error	+5.0	deg	
0.0 to +1000 Hz	FrequencyError, limit for frequency error	+90	Hz	
Description of command			Status	FW vers.
This command defines upper limits for the peak and RMS phase error averaged over several bursts as well as for the averaged frequency error. The default frequency error is 90 Hz for GSM900, 180 Hz for GSM1800/1900.			all	≥1.15

CONFigure:MODulation:LIMit:UPPer:MODE *<Mode>*				Upper Limit Check on/off
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Upper limit check on Upper limit check off	ON	–	–
Description of command			Status	FW vers.
This command switches on or off the tolerance check with respect to the upper limit lines (current and average).			all	≥2.0

CONFigure:MODulation:LIMit:LOWer:MODE ***<Mode>***				Lower Limit Check on/off
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Lower limit check on Lower limit check off	ON	–	–
Description of command			Status	FW vers.
This command switches on or off the tolerance check with respect to the lower limit lines (current and average).			all	≥2.0

CONFigure:MODulation:LIMit:DEFault ***<Mode>***				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	–
Description of command			Status	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*			all	

Subsystem SUBarrays:MODulation

The subsystem *SUBarrays:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation <Mode>,<Range>{,<Range>}				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>.	Description of parameters	Def. value	Def. unit	Unit ring
–100 µs to 700 µs, **0 to 588**	Start time in current range Number of samples in current range	NAN NAN	µs –	
Description of command			Status	FW vers.
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays:MODulation` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. The subranges may overlap but must be within the total range of the *power vs time* measurement. If the combination of start time and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.			all	2.0

Subsystem MODulation[:RESult]

The subsystem *MODulation[:RESULT]* contains the commands for measurement and output of the frequency and phase error and their comparison with the tolerance values. The subsystem corresponds to the different output elements in the graphical measurement menu *MODulation.*

READ[:SCALar]:MODulation[:RESult]	Scalar Results: Start single shot measurement and return results
FETCh[:SCALar]:MODulation[:RESult]?	Read out meas. results (unsynchronized)
SAMPle[:SCALar]:MODulation[:RESult]?	Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
PhErrPeakCurrent,	−100.0 deg to +100.0 deg	NAN	deg	Angle
PhErrPeakAverage,	−100.0 °to +100.0 deg	NAN	deg	
PhErrPeakMaxMin,	−100.0 °to +100.0 deg	NAN	deg	
PhErrRMSCurrent,	−100.0 deg to +100.0 deg	NAN	deg	Angle
PhErrRMSAverage,	−100.0 deg to +100.0 deg	NAN	deg	
PhErrRMSMaxMin,	−100.0 deg to +100.0 deg	NAN	deg	
FreqErrCurrent,	−1000.0 Hz to + 1000.0 Hz	NAN	Hz	Frq.
FreqErrAverage,	−1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrMaxMin	−1000.0 Hz to + 1000.0 Hz	NAN	Hz	
AvgBurstPowerCurr	−100.0 dBm to + 20.0 dBm	NAN	dBm	
BurstsOutOfTol	0.0 % to 100.0 %	NAN	%	

Description of command	Status	FW vers.
These commands are always queries. They start a measurement and output all scalar, numeric measurement results. These are:	all	≥1.15

Maximum phase error with single-value measurement	*phase error peak current*
Maximum phase error with average measurement	*phase error peak average*
Maximum phase error with extreme-value measurement	*phase error peak max./min.*
Rms phase error with single-value measurement	*phase error RMS current*
Rms phase error with average measurement	*phase error RMS average*
Rms phase error with extreme-value measurement	*phase error RMS max./min.*
Frequency error with single-value measurement	*frequency error current*
Frequency error with average measurement	*frequency error average*
Frequency error with extreme-value measurement	*frequency error max./min.*
Average burst power with single-value measurement	*avg. burst power current*
Relative portion of faulty burst	*bursts out of tolerance*

Average measurement means that the results of the single-value measurement are averaged over several bursts. Extreme-value measurement means that the extreme value is determined from the results of the single-value measurement.

READ:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]? Subarray Results
READ:SUBarrays:MODulation[:RESult]:[:BURSt]AVERage?
READ:SUBarrays:MODulation[:RESult]:[:BURSt]MMAX?
Start measurement and wait for end *RUN*
FETCh:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?
FETCh:SUBarrays:MODulation[:RESult]:[:BURSt]AVERage?
FETCh:SUBarrays:MODulation[:RESult]:[:BURSt]MMAX?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?
SAMPle:SUBarrays:MODulation[:RESult]:[:BURSt]AVERage?
SAMPle:SUBarrays:MODulation[:RESult]:[:BURSt]MMAX?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the phase error versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:MODulation` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:MODulation` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).	all	2.0

CALCulate:MODulation[:RESult]:LIMit:MATChing? Bursts out of Tolerance

Returned values	Value range	Def. value	Def. unit	Unit ring
PhErrPeakCurrent,	**For all measured values:**	INV	–	–
PhErrPeakAverage,		INV	–	
PhErrPeakMaxMin,		INV	–	
PhErrRMSCurrent,	**NMAU | NMAL | INV | OK**	INV	–	
PhErrRMSAverage,		INV	–	
PhErrRMSMaxMin,		INV	–	
FreqErrCurrent,		INV	–	
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPowerCurr		INV	–	

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible error limits for the scalar measured values (see command above) have been exceeded.	all	≥1.15

The following messages may be output for all measured values:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK.	all tolerances matched	

READ:ARRay:MODulation[:RESult]:BURSt[:CURRent]? Phase error in burst
READ:ARRay:MODulation[:RESult]:[:BURSt]AVERage?
READ:ARRay:MODulation[:RESult]:[:BURSt]MMAX?
Start single shot measurement and return results *RUN*
FETCh:ARRay:MODulation[:RESult]:BURSt[:CURRent]?
FETCh:ARRay:MODulation[:RESult]:[:BURSt]AVERage?
FETCh:ARRay:MODulation[:RESult]:[:BURSt]MMAX?
Read measurement results (unsynchronized) *RUN*
SAMPle:ARRay:MODulation[:RESult]:BURSt[:CURRent]?
SAMPle:ARRay:MODulation[:RESult]:[:BURSt]AVERage?
SAMPle:ARRay:MODulation[:RESult]:[:BURSt]MMAX?
Read measurement results (synchronized) *RUN*

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 deg to +100.0 deg,	1st value for phase error,	NAN	deg	–
... ,	...,	...	...	
–100.0 deg to +100.0 deg	xth value for phase error	NAN	deg	

Description of command	Status	FW vers.
These commands are always queries. They output the values for the phase error of the burst in a fixed ¼-bit pattern. The calculation of *current, average, and mmax* (Min:/Max.) results is explained in chapter 3 (cf. *display mode*).	all	≥1.15

Test Object SPECtrum due to MODulation

The subsystem *SPECtrum:MODulation* measures the off-carrier power due to the modulation of the GSM signal. The subsystem corresponds to the measurement menu *Spectrum* and the associated configuration popups.

Control of Measurement – Subsystem SPECtrum:MODulation

The subsystem *SPECtrum:MODulation* controls the spectrum measurement.

INITiate:SPECtrum:MODulation **ABORt:SPECtrum:MODulation** **STOP:SPECtrum:MODulation** **CONTinue:SPECtrum:MODulation**	Start new measurement Abort running measurement and switch off Stop measurement after current stat. cycle Next measurement step (only *stepping mode*)		*RUN* *OFF* *STOP* *RUN*
Description of command		Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status indicated in the top right column.		all	V1.20

CONFigure:SPECtrum:MODulation:EREPorting <*Mode*>		Event Reporting		
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	–
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).			all	V1.20

FETCh:SPECtrum:MODulation:STATus?		Measurement Status		
Returned values	Description of parameters	Def. value	Def. unit	Unit ring
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	–
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	–
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	–
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).			all	V1.20

Subsystem SPECTrum:MODulation:CONTrol

The subsystem *SPECtrum:MODulation:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Statistics* tabs in the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:MODulation:CONTrol *<Mode>,<Statistics>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar |	Only scalar measured values	ARRay	–	–
ARRay	Scalar measured values and arrays			
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 |	Number of bursts per statistics cycle	200	–	–
NONE	Statistics off (equivalent to 1)			
Description of command			Status	FW vers.
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.			all	V1.20

CONFigure:SPECtrum:MODulation:CONTrol:REPetition *<Repetition>,<StopCondition>, <Stepmode>*				Test cycles
<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous |	Continuous measurement (until `STOP` or `ABORT`)	SING	–	–
SINGleshot |	Single shot measurement (until `Status = RDY`)			
1 to 10000	Multiple measurement (*counting*, until `Status = STEP | RDY`)			
<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror |	Stop measurement in case of error *(stop on error)*	NONE	–	–
NONE	Continue measurement even in case of error			
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP |	Interrupt measurement after each statistics cycle	NONE	–	–
NONE	Continue measurement according to its rep. mode			
Description of command			Status	FW vers.
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. Note: *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*			all	V1.20

DISPlay:SPECtrum:MODulation:CONTrol:GRID *<Enable>*				Grid
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Switch on grid lines	ON	–	–
OFF	Switch off grid lines			
Description of command			Status	FW vers.
This command switches the grid lines in the test diagrams on or off.			all	V1.20

CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle <Enable>

Enable/disable measurement points

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Switch on measurement point <nr>	ON	–	–
OFF	Switch off measurement point <nr>			

Description of command	Status	FW vers.
This command switches the measurement at the individual frequency points no. 1 to 11 (numbered by the numeric suffix <nr>) on or off. Each number denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.1 MHz, <nr>=11 to ±1.8 MHz.	all	V1.20

CONFigure:SPECtrum:MODulation:CONTrol:DEFault *<Mode>*

Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem are set to default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.	all	2.0

Test Configuration

The commands of the following subsystems configure the spectrum due to modulation. They correspond to the *due to Modulation* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:MODulation:LIMit:LINE

The subsystem *SPECtrum:MODulation:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to modulation measurement The subsystem corresponds to the *due to Modulation* sections in the index card *Limit Lines* in the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>:ENABle <Enable>			
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr> ***<MinPwLevelRel>, <MaxPwLevelRel>, <AbsPwLevel>, <Enable>***			Limits
Numeric Suffix	Value range	Description of parameters	Def. value
<nr>	1 to11	Measurement point (frequency) no.	
Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Defined section on/off	See below
<MinPwLevelRel>,	–99.9 dB to 99.9 dB	Limit for relative power below the interpolation range	See below
<MaxPwLevelRel>,	–99.9 dB to 99.9 dB	Limit for relative power above the interpolation range	See below
<AbsPwLevel>,	–99.9 dBm to 99.9 dBm	Alternative absolute power limit	
<Enable>	ON | OFF	Enable or disable limit check for frequency point <nr>	See below
Description of command		Status	FW vers.
These commands activate and define limit lines for the spectrum due to modulation measurement. Each number <nr> denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.1 MHz, <nr>=11 to ±1.8 MHz. The limits are defined at up to 11 fixed frequencies numbered by the numeric suffix <nr> and as a function of the MS output power level. Outside the interpolation range defined via `CONFigure:SPECtrum:MODulation:LIMit:LINE :REFPower[:UPPer]`, the fixed relative power limits *<MinPwLevelRel> and <MaxPwLevelRel>* apply. Inside this range, the limits are derived from these values by linear interpolation. As an alternative, an absolute power limit is set. For a more detailed explanation see chapter 4. For totally switching on or off the limit check please use the command `CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer] <Mode>`		all	V1.20

Default values for GSM900:

Frequency	Min.P. Lev.rel.	Max.P. Lev.rel.	Level abs.
± 0.10 MHz	+0.5 dB	+ 0.5 dB	– 36.0 dBm
± 0.20 MHz	–30.0 dB	– 30.0 dB	– 36.0 dBm
± 0.25 MHz	–33.0 dB	– 33.0 dB	– 36.0 dBm
± 0.40 MHz	–60.0 dB	– 60.0 dB	– 36.0 dBm
± 0.60 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 0.80 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.00 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.20 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.40 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.60 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.80 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm

Default values for GSM1800/1900:

Frequency	Min.P. Lev.rel.	Max.P. Lev.rel.	Level abs.
± 0.10 MHz	+0.5 dB	+ 0.5 dB	– 36.0 dBm
± 0.20 MHz	–30.0 dB	– 30.0 dB	– 36.0 dBm
± 0.25 MHz	–33.0 dB	– 33.0 dB	– 36.0 dBm
± 0.40 MHz	–60.0 dB	– 60.0 dB	– 36.0 dBm
± 0.60 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 0.80 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.00 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.20 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.40 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.60 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.80 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm

CONFigure:SPECtrum:MODulation:LIMit:LINE:REFPower[:UPPer] ***<Minimum>, <Maximum>*** Reference power

Parameters	Value range	Description of parameters	Def. value
<Minimum>,	-99.9 dBm to 99.9 dBm	Reference power for the minimum power level	33 dBm
<Maximum>	-99.9 dBm to 99.9 dBm	Reference power for the maximum power level	39 dBm

Description of command	Status	FW vers.
This command defines the MS output power range where the relative limit lines are given by linear interpolation between a minimum and a maximum relative power level. See command `CONFigure:SPECtrum:MODulation:LIMit :LINE:UPPer<nr>` and detailed explanation in chapter 4. The value range applies with the additional condition `<Minimum> ≤ <Maximum> - 1dB.`	all	V1.25

CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer] ***<Mode>*** Limits on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Switch on limit lines	ON	–	–
OFF	Switch off limit lines			

Description of command	Status	FW vers.
This command switches all limit lines for the spectrum due to modulation measurement on or off.	all	V1.20

CONFigure:SPECtrum:MODulation:LIMit:LINE:DEFault *<Enable>*		Default Settings		
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem are set to default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			
Description of command			Status	FW vers.
If used as a setting command with *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.			all	2.0

Subsystem SUBarrays:SPECtrum:MODulation

The subsystem *SUBarrays:SPECtrum:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum:MODulation <Mode>,<Range>{,<Range>}		Definition of Subarrays		
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>	Description of parameters	Def. value	Def. unit	Unit ring
–1.8 MHz to 1.8 MHz,	Frequency of first point in current range	NAN	MHz	
1 to 23	Number of samples in current range	NAN	–	
Description of command			Status	FW vers.
This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:MODulation` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located at fixed frequencies (see command `CONFigure:SPECtrum:MODulation:LIMit:LINE<nr>`). The subranges may overlap but must be within the total range of the *spectrum due to modulation* measurement. If the combination of start frequency and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.			all	2.0

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to modulation measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:MODulation[:RESult]

The subsystem *SPECtrum:MODulation[:RESult]* measures and returns the frequency spectum (due to modulation) and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum.*

Scalar Results:

READ[:SCALar]:SPECtrum:MODulation[:RESult]? Start single shot measurement and return results

FETCh[:SCALar]:SPECtrum:MODulation[:RESult]? Read measurement results (unsynchronized)

SAMPle[:SCALar]:SPECtrum:MODulation[:RESult]? Read measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
Reference Power,	–100.0 dBm to +100.0 dBm	NAN	dBm	
Matching	INV | MATC | NMAT | OUT | NTR | BNF | OFF	INV	–	

Description of command	Status	FW vers.
These commands are always queries. - `READ` starts a single shot measurement and returns the results. - `FETCh` outputs the current results regardless of the measurement state. - `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results. For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual. The reference power is the absolute carrier power measured as specified in the GSM standard. The following messages may be output for the value *Matching*: INV *invalid* MATC *matching* NMAT *not matching* OUT *out of range* NTR *no Trigger* BNF *burst not found* OFF *off*	all	V1.20

Spectrum Results

READ:ARRay:SPECtrum:MODulation[:RESult]? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MODulation[:RESult]? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MODulation[:RESult]? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB,	Power at measurement point 1	NAN	dB	FG
...,	...	...	...	Power
–100.0 dB to + 20.0 dB	Power at measurement point *n*	NAN	dB	Level

Description of command	Status	FW vers.
These commands are always queries. They return the off-carrier power due to modulation at the measurement points defined via the command `CONFigure:ARRay:SPECtrum:MODulation:RANGe`.	all	V1.20

READ:SUBarrays:SPECtrum:MODulation[:RESult]? Subarray Results
Start single shot measurement and return results *RUN*
FETCh:SUBarrays:SPECtrum:MODulation[:RESult]?
Read meas. results (unsynchronized) *RUN*
SAMPle:SUBarrays:SPECtrum:MODulation[:RESult]?
Read results (synchronized) *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 20.0 dB	Power[1], 1st value for power	NAN	dB	
...	...	...	...	
–100.0 dB to + 20.0 dB	Power[x], xth value for power	NAN	dB	

Description of command	Status	FW vers.
These commands are always queries. They output the off-carrier power due to modulation in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:MODulation` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:SPECtrum:MODulation` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned by subrange.	all	2.0

Test Object SPECtrum due to SWITching

The subsystem *SPECtrum:SWITching* measures the off-carrier power due to the bursty nature of the GSM signal. The subsystem corresponds to the measurement menu *Spectrum* and the associated configuration popups.

Control of Measurement – Subsystem SPECtrum:SWITching

The subsystem *SPECtrum:SWITching* controls the spectrum due to switching measurement.

INITiate:SPECtrum:SWITching	Start new measurement	*RUN*
ABORt:SPECtrum:SWITching	Abort running measurement and switch off	*OFF*
STOP:SPECtrum:SWITching	Stop measurement after current stat. cycle	*STOP*
CONTinue:SPECtrum:SWITching	Next measurement step (only *stepping mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the measurement, setting it to the status indicated in the top right column.	all	V1.20

CONFigure:SPECtrum:SWITching:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).	all	V1.20

FETCh:SPECtrum:SWITching:STATus? Measurement Status

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle	NONE	–	–
NONE,	No counting mode set			
1 to 1000 |	Counter for current evaluation period within a cycle	NONE	–	–
NONE	Statistic count set to off			

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	all	V1.20

Subsystem SPECTrum:SWITching:CONTrol

The subsystem *SPECtrum:SWITching:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Statistics* tabs in the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:SWITching:CONTrol ***<Mode>,<Statistics>***				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Only scalar measured values Scalar measured values and arrays	ARRay	–	–
<Statistics>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	10	–	–
Description of command			Status	FW vers.
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.			all	V1.20

CONFigure:SPECtrum:SWITching:CONTrol:REPetition ***<Repetition>,<StopCondition>, <Stepmode>***				Test cycles
<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	–
<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	–
Description of command			Status	FW vers.
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot*			all	V1.20

DISPlay:SPECtrum:SWITching:CONTrol:GRID ***<Enable>***				Grid
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	–
Description of command			Status	FW vers.
This command switches the grid lines in the test diagrams on or off.			all	V1.20

CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle <Enable>

Enable/Disable Measurement Points

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	Switch on measurement point <nr> Switch off measurement point <nr>	ON	–	–

Description of command	Status	FW vers.
This command switches the measurement at the individual frequency points no. 1 to 4 (numbered by the numeric suffix <nr>) on or off.	all	V1.20

CONFigure:SPECtrum:SWITching:CONTrol:DEFault *<Mode>*

Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem correspond to their default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			

Description of command	Status	FW vers.
If used as a setting command with the parameter *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.	all	2.0

Test Configuration

The commands of the following subsystems configure the spectrum due to switching. They correspond to the *due to Switching* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:SWITching:LIMit:LINE

The subsystem *SPECtrum:SWITching:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to switching measurement. The subsystem corresponds to the *due to Switching* sections in the index card *Limit Lines* in the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:SWITchingLIMit:LINE[:UPPer]<nr>:ENABle <Enable>
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr> Limits

<PowerLevel>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>, <Enable>

Numeric Suffix	Value range	Description of parameters	Def. value
<nr>	1 to10	Power level no.	
Parameters	**Value range**	**Description of parameters**	**Def. value**
<Enable>	ON | OFF	Defined section on/off	See below
<Power level>,	–100 dBm to 30 dBm	MS output power for power level <nr>	See below
		Limit for the measurement point at:	
<Limit at 0.4 MHz>,	–100 dBm to 30 dBm	0.4 MHz from carrier frequency	See below
<Limit at 0.6 MHz>,	–100 dBm to 30 dBm	0.6 MHz from carrier frequency	
<Limit at 1.2 MHz>,	–100 dBm to 30 dBm	1.2 MHz from carrier frequency	
<Limit at 1.8 MHzl>,	–100 dBm to 30 dBm	1.8 MHz from carrier frequency	
<Enable>	ON | OFF| DEFault	Enable or disable limit check for power level <nr>	See below

Description of command	Status	FW vers.
These commands activate and define limit lines for the spectrum due to switching measurement. The value range for the individual power levels <nr> at the same frequency applies with the additional conditions `<PowerLevel(n+1)> ≤ <PowerLevel(n)> - 1 dB` and `|<PowerLevel(n+1)> - <PowerLevel(n)>| ≤ 100 dB.`	all	V1.20

The limits are defined depending on 10 definable MS output power levels numbered by the numeric suffix <nr> and four fixed frequency offsets from the carrier. The first parameter defines the power of level no. <nr>. For the 1st and the 10th level, limit values are entered: The levels then comprise all powers greater than or less than the specified limits.

For switching on or off one measurement point over all power levels, please use the command

```
CONFigure:SPECtrum:SWITching:LIMit:LINE:ENABle[:UPPer]
```

For totally switching on or off the limit check please use the command

```
CONFigure:SPECtrum:SWITching:LIMit:LINE:MODE[:UPPer]
      <Mode>
```

Default values for GSM900:

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 39.0	–13.0	–21.0	–21.0	–24.0
2	37.0	–15.0	–21.0	–21.0	–24.0
3	35.0	–17.0	–21.0	–21.0	–24.0
4	33.0	–19.0	–21.0	–21.0	–24.0
5	31.0	–21.0	–23.0	–23.0	–26.0
6	29.0	–23.0	–25.0	–25.0	–28.0
7	27.0	–23.0	–26.0	–27.0	–30.0
8	25.0	–23.0	–26.0	–29.0	–32.0
9	23.0	–23.0	–26.0	–31.0	–34.0
10	≤ 21.0	–23.0	–26.0	–32.0	–36.0

Default values for GSM1800:

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 36.0	–16.0	–21.0	–21.0	–24.0
2	34.0	–18.0	–21.0	–21.0	–24.0
3	32.0	–20.0	–22.0	–22.0	–25.0
4	30.0	–22.0	–24.0	–24.0	–27.0
5	28.0	–23.0	–25.0	–26.0	–29.0
6	26.0	–23.0	–26.0	–28.0	–31.0
7	24.0	–23.0	–26.0	–30.0	–33.0
8	22.0	–23.0	–26.0	–31.0	–35.0
9	≤ 20.0	–23.0	–26.0	–32.0	–36.0

Default values for GSM1900:

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 33.0	–19.0	–22.0	–22.0	–25.0
2	32.0	–20.0	–22.0	–22.0	–25.0
3	30.0	–22.0	–24.0	–24.0	–27.0
4	28.0	–23.0	–25.0	–26.0	–29.0
5	26.0	–23.0	–26.0	–28.0	–31.0
6	24.0	–23.0	–26.0	–30.0	–33.0
7	22.0	–23.0	–26.0	–31.0	–35.0
8	≤ 20.0	–23.0	–26.0	–32.0	–36.0

CONFigure:SPECtrum:SWITchingLIMit:LINE:ENABle[:UPPer] Limit Check on/off
<MP04>, <MP06>, <MP12>, <MP18>

Parameters	Value range	Description of parameters	Def. value
		Switch limit check on or off for all power levels at the measurement point	
<MP04>	ON | OFF	0.4 MHz from carrier frequency	ON
<MP06>,	ON | OFF	0.6 MHz from carrier frequency	ON
<MP12>,	ON | OFF	1.2 MHz from carrier frequency	ON
<MP18>	ON | OFF	1.8 MHz from carrier frequency	ON

Description of command	Status	FW vers.
This command switches the limit check at the four measurement points on or off.	all	V1.20

CONFigure:SPECtrum:SWITchingLIMit:LINE:MODE[:UPPer] *<Mode>* Limits on/off

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	Switch on limit lines	ON	–	–
OFF	Switch off limit lines			

Description of command	Status	FW vers.
This command switches all limits for the spectrum due to switching measurement on or off.	all	V1.20

CONFigure:SPECtrum:SWITching:LIMit:LINE:DEFault *<Enable>*		Default Settings		
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	All the parameters of the subsystem are set to default values	ON	–	
OFF	At least one parameter of the subsystem differs from its default value			
Description of command			Status	FW vers.
If used as a setting command with *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* has no effect). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.			all	2.0

Subsystem SUBarrays:SPECtrum:SWITching

The subsystem *SUBarrays:SPECtrum:SWITching* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum:SWITching <Mode>,<Range>{,<Range>}		Definition of Subarrays		
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
ALL | **ARIThmetical |** **MINimum |** **MAXimum,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range	ALL	–	–
<Range>	Description of parameters	Def. value	Def. unit	Unit ring
–1.8 MHz to 1.8 MHz,	Frequency of first point in current range	NAN	MHz	
1 to 9	Number of samples in current range	NAN	–	
Description of command			Status	FW vers.
This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:SWITching` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located at fixed frequencies (see command `CONFigure:SPECtrum:SWITching:LIMit:LINE<nr>`). The subranges may overlap but must be within the total range of the *spectrum due to switching* measurement. If the combination of start frequency and number of points set implies that the measurement range is exceeded, the number of points will be reduced automatically. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.			all	2.0

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to switching measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:SWITching[:RESult]

The subsystem *SPECtrum:SWITching[:RESult]* measures and returns the frequency spectum (due to switching) and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum.*

READ[:SCALar]:SPECtrum:SWITching[:RESult]?	Scalar Results Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:SWITching[:RESult]?	Read measurement results (unsynchronized)
SAMPle[:SCALar]:SPECtrum:SWITching[:RESult]?	Read measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	Unit ring
Reference Power,	–100.0 dBm to +100.0 dBm	NAN	dBm	
Matching	INV | MATC | NMAT | OUT | NTR | BNF | OFF	INV	–	

Description of command	Status	FW vers.
These commands are always queries.	all	V1.20

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the results without taking care of the measurement state.
- `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The reference power is the absolute carrier power measured as specified in the GSM standard. The following messages may be output for the value *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no Trigger*
BNF	*Burst not found*
OFF	*off*

	Spectrum Result
READ:ARRay:SPECtrum:SWITching[:RESult]?	Start single shot measurement and return results
FETCh:ARRay:SPECtrum:SWITching[:RESult]?	Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:SWITching[:RESult]?	Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 100.0 dB,	Power at measurement point 1	NAN	dBm	FG
...,	...	...	...	Power
–100.0 dB to + 100.0 dB	Power at measurement point *n*	NAN	dBm	Level

Description of command	Status	FW vers.
These commands are always queries. They return the off-carrier power due to switching at the measurement points defined via the command `CONFigure:ARRay:SPECtrum:SWITching:RANGe`.	all	V1.20

READ:SUBarrays:SPECtrum:SWITching[:RESult]?	Start measurement and wait for end		Subarray Results	*RUN*
FETCh:SUBarrays:SPECtrum:SWITching[:RESult]?	Read meas. results (unsynchronized)			*RUN*
SAMPle:SUBarrays:SPECtrum:SWITching[:RESult]?	Read results (synchronized)			*RUN*
Ret. values by subrange	Description of parameters	Def. value	Def. unit	Unit ring
–100.0 dB to + 100.0 dB	Power[1], 1st value for power	NAN	dB	
...	...	...	...	
–100.0 dB to + 100.0 dB	Power[x], xth value for power	NAN	dB	
Description of command			Status	FW vers.
These commands are always queries. They output the off-carrier power due to switching in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:SWITching` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above. The `CONFigure:SUBarrays:SPECtrum:SWITching` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned by subrange.			all	2.0

Test Object Sensitivity

The subsystem *Sensitivity* comprises the commands for all measurements of the sensitivity context. The settings are used to assess the quality of transmission between the CMU and the device under test. The subsystem corresponds to the main menu *Sensitivity* and the associated popup menu *Sensitivity Configuration.*

Test Configuration – Subsystem SENSitivity:CONTrol

The subsystem *SENSitivity:CONTrol* controls the sensitivity measurements.

CONFigure:SENSitivity:CONTrol:HTIMe <AGCTime>, <*SynchTime*>AGC Holdoff Time, Sync Holdoff Time

<value>	Description of parameters	Def. value	Def. Unit	Unit ring
0 s to 100 s	Automatic gain control	0.5	s	Time
<value>	Description of parameters	Def. value	Def. Unit	Unit ring
0 s to 100 s	Bit stream synchronization	0.2	s	Time

Description of command	Status	FW vers.
This command defines hold off times during which the mobile can adapt itself to the new RF level at the beginning of the *Sensitivity* measurement and send back the bit stream received. By reducing the hold off times, the measurement can be speeded up. The default settings for both times do not depend on the application.		≥2.0

CONFigure:SENSitivity:CONTrol:DEFault Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to default values The parameters partly or completely differ from the default value	ON	–	–

Description of command	Status	FW vers.
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* has no effect). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.	all	≥2.0

Test Object Sensitivity – Single Shot

The subsystem *SENSitivity:SINGleShot* contains the commands for sensitivity measurements in the single shot repetition mode. The subsystem corresponds to the main menu *Sensitivity,* application *Single Shot*, and the corresponding sections of the associated popup menu *Sensitivity Configuration.*

Control of Measurement – Subsystem SENSitivity:SSHot

The subsystem *SENSitivity:SSHot* controls the single shot sensitivity measurements.

CONFigure:SENSitivity:SSHot:TSETup *<TestSetup>*				Test Setup
<TestSSetup>	Description of parameters	Def. value	Def. unit	Unit ring
TS1 | **TS2 |** ... **TS10**	Single Shot Test Setup 1 ... Single Shot Test Setup 10	TS1	–	–
Description of command			Status	FW vers.
This command selects one out of 10 test setups, i.e. one data set parametrizing a particular single shot sensitivity measurement. When a test setup is switched over, the running measurement is stopped and all measured values are set invalid.			CEST	≥2.00

INITiate:SENSitivity:SSHot **ABORt:SENSitivity:SSHot** **STOP:SENSitivity:SSHot** **CONTinue:SENSitivity:SSHot**	Start new measurement Abort running measurement and switch off Stop measurement Next measurement step (only *stepping mode*)		*RUN* *OFF* *STOP* *RUN*
Description of command		Status	FW vers.
These commands do not exist as queries. They start or stop the current single shot measurement, setting it to the status indicated in the top right column.		all	≥2.00

CONFigure:SENSitivity:SSHot:EREPorting *<Mode>*				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	–
Description of command			Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).			all	≥2.00

FETCh:SENSitivity:SSHot:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 50000 |	Counter for current evaluation period (frame)	NONE	–	–
NONE	Statistic count set to off (only 1 frame)			
Description of command			Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapter 5).			all	≥2.00

Subsystem SENSitivity:SSHot:CONTrol

The subsystem *SENSitivity:SSHot:CONTrol* sets the control parameters for the single shot sensitivity measurements. The subsystem corresponds to the index card *Control* in the popup menu *Sensitivity Configuration.*

CONFigure:SENSitivity:SSHot<nr>:CONTrol *<Mode>, <FramesToSend>*				Meas. Mode, Frames
<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
RFER |	Residual bit error rate, frame erasure rate	BER	–	
BER	Bit error rate			
BBB	Burst by burst			
<FramesToSend>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 50000 |	No. of frames to be sent	See below	–	
NONE	No average (only 1 frame considered)			
Description of command			Status	FW vers.
This command defines the measured value and the number of frames to be sent in a single shot measurement, constituting a statistics cycle. The suffix <nr> refers to the selected test setup (<nr> = 1 to 10). For definition of the measured value (BER, RFER etc.) see chapter 4. The following default settings are valid for the command parameters:			all	≥2.00

<nr>	1	2	3	4	5	6	7	8	9	10
Mode	BER	BER	BER	BER	BER	BER	BER	BER	BER	BER
Frames	100	100	500	500	100	500	500	100	100	100

CONFigure:SENSitivity:SSHot<nr>:CONTrol:REPetition *StopCondition>*,<Stepmode>

Test Cycles

<StopCondition>	Description of parameters	Def. value	Def. unit	Unit ring
ALIMits |	Measurement aborted when all permissible limit values are violated	See below	–	–
FLIMit |	Aborted when first limit value is violated			
NONE	Not aborted, measurement over all frames			

<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP |	Interrupt measurement after each statistics cycle	NONE	–	–
NONE	Continue measurement according to its rep. mode			

Description of command	Status	FW vers.
This command determines the stop condition and the stepping mode for the measurement. The repetition mode of the measurement (single shot) is identified by the `SSHot` keyword. Depending on the application, the following default settings are valid:	all	≥2.00

<nr>	1	2	3	4	5	6	7	8	9	10
StopCond	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM

CONFigure:SENSitivity:SSHot<nr>:CONTrol[:TCH]:LEVel:UTIMeslot *<Level>*

TCH BER Level, Used Timeslot

<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–137 dBm to –27 dBm	RF1 level in used timeslot	See below	dBm	Power level
–137 dBm to –10 dBm	RF2 level in used timeslot			
–90 dBm to +13 dBm	RF3 OUT level in used timeslot			

Description of command	Status	FW vers.
This command defines the absolute level of the traffic channel (*TCH*) in the used timeslot for the single shot application <nr>. This level applies to the sensitivity measurement only. The default setting depends on the application (all level values in dBm):	all	≥2.00

<nr>	1	2	3	4	5	6	7	8	9	10
Level	–102.0	–104.0	–102.0	–104.0	–100.0	–100.0	–100.0	–102.0	–102.0	–102.0

CONFigure:SENSitivity:SSHot<nr>:CONTrol[:TCH]:LEVel:UNTimeslot *<Level>*

TCH BER Level, Unused Timeslot

<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–127 dB to +127 dB	Level in unused timeslot	s. u.	dB	Ratio

Description of command	Status	FW vers.
This command defines the relative level of the traffic channel (*TCH*) in the unused timeslot for the single shot application <nr>. This level applies to the sensitivity measurement only. The value range mentioned above is valid provided that the sum of the absolute level of the used timeslot and the relative value for the unused timeslot does not exceed the value ranges for the absolute level of the used timeslot (for RF 1, RF 2 and RF 3 OUT).	all	≥2.00

The default setting depends on the application (all level values in dB):

<nr>	1	2	3	4	5	6	7	8	9	10
Level	–18.0	–16.0	–18.0	–16.0	–20.0	–20.0	–20.0	–18.0	–18.0	–20.0

CONFigure:SENSitivity:SSHot<nr>:CONTrol:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to default valuess The parameters partly or completely differ from the default values	ON	–	–
Description of command			Status	FW vers.
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* has no effect). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.			all	≥2.0

Subsystem SENSitivity:SSHot:LIMit

The subsystem *SENSitivity:SSHot:LIMit* defines tolerance values for the single shot sensitivity measurements. The subsystem corresponds to the index card *Limits* in the popup menu *Sensitivity Configuration.*

CONFigure:SENSitivity:SSHot<nr>:LIMit:CLII ***<ClassIIBER>***				Class II Bits
<ClassIIBER>	Description of parameters	Def. value	Def. unit	Unit ring
0 % to 100 %	Upper limit of error rate for class II bits	0.2	%	Ratio
Description of command			Status	FW vers.
This command defines an upper limit for the bit error rate of class II (unprotected bits, see chapter 4) for application <nr>. Irrespective of the application, the default setting is 2 %.				≥2.00

CONFigure:SENSitivity:SSHot<nr>:LIMit:CLIB ***<ClassIbBER>***				Class Ib Bits
<ClassIbBER>	Description of parameters	Def. value	Def. unit	Unit ring
0 % to 100 %	Upper limit of error rate for class Ib bits	0.4	%	Ratio
Description of command			Status	FW vers.
This command defines an upper limit for the bit error rate of class IB (partly protected bits, see chapter 4) for the application <nr>. Irrespective of the application, the default setting is 0.4 %.				≥2.00

CONFigure:SENSitivity:SShot<nr>:LIMit:FERRors <Frame Errors>				Frame Errors
<FERRors>	Description of parameters	Def. value	Def. unit	Unit ring
0 % to 100 %	Upper limit for erased frame errors	0.1	%	Ratio
Description of command			Status	FW vers.
This command defines an upper limit for frame errors for the application <nr>. Irrespective of the application, the default setting is 0.1 %.				≥2.00

CONFigure:SENSitivity:SSHot<nr>:LIMit:DEFault		Default Settings		
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to default values The parameters partly or completely differ from the default value	ON	–	–
Description of command			Status	FW vers.
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* has no effect). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.			all	≥2.0

Measured Values – Subsystem SENSitivity:SSHot[:RESult]

The subsystem *SENSitivity:SSHot[:RESULT]* measures and outputs the bit error rate and compares it with the tolerance values. The subsystem corresponds to the measurement menus *Sensitivity* for the single shot type of measurement and measured values *(RBERFER, BER, BurstByBurst, RBERUFR, RBERESIDR, RBEREVSIDR).*

	Scalar Results:
READ[:SCALar]:SENSitivity:SSHot[:RESult]?	Start single shot measurement and return results
FETCh[:SCALar]:SENSitivity:SSHot[:RESult]?	Read out meas. results (unsynchronized)
SAMPle[:SCALar]:SENSitivity:SSHot[:RESult]?	Read out measurement results (synchronized)

Return for RFER	Value range	Def. value	Def. unit	Unit ring
ProgressTime,	0.0% to 100.0%	NAN	%	
ClassIIBits,	0.000% to 100.000%	NAN	%	
ClassIbBits,	0.000% to 100.000%	NAN	%	
FER,	0.000% to 100.000%	NAN	%	
CRCErrors,	1 to 50000	NAN	–	
Status	INV | PASS | FAIL | TMER | IMP	INV	–	
Return for BER	**Value range**	**Def. value**	**Def. unit**	**Unit ring**
ProgressTime,	0.0% to 100.0%	NAN	%	
ClassIIBits,	0.000% to 100.000%	NAN	%	
ClassIbBits,	0.000% to 100.000%	NAN	%	
CRCErrors,	1 to 50000	NAN	–	
Status	INV | PASS | FAIL | TMER | IMP	INV	–	
Return for BBB	**Value range**	**Def. value**	**Def. unit**	**Unit ring**
ProgressTime,	0.0% to 100.0%	NAN	%	
ClassIIBits,	0.000% to 100.000%	NAN	%	
CRCErrors,	1 to 50000	NAN	–	
Status	INV | PASS | FAIL | TMER | IMP	INV	–	

Description of command	Status	FW vers.
These commands are always queries. They start a bit-error-rate test in the single shot repetition mode and output the measurement results (see also detailed explanation of measured values in chapter 4). The results depend on the measurement mode set via the `CONFigure:SENSitivity:SSHot<nr> :CONTrol` command (RFER, BER, or BBB). They are	all	≥2.20

ProgressTime	Relative progress of the measurement
ClassIIBits	(Residual) bit error rate for class II bits
ClassIbBits	(Residual) bit error rate for class Ib bits
FER	Frame erasure rate
CRCErrors	Cyclic redundancy check (CRC) errors
Status	Measurement status

The following messages can be output for the measurement status:

INV	Measurement invalid	*invalid*
PASS	All tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
TMER	CMU could not synchronize	*too many errors*
IMP	Measurement impossible, therefore invalid	*impossible*

CALCulate:SENSitivity:SSHot[:RESult]:LIMit:MATChing? Limit Matching

Return for RFER	Value range	Def. value	Def. unit	Unit ring
Total,	**PASS | FAIL | INV | TMER | IMP**	INV	–	
ClassIIBits,	**NMAU | INV | OK**	INV	–	
ClassIbBits,	**NMAU | INV | OK**	INV	–	
FER,	**NMAU | INV | OK**	INV	–	
CRCErrors	**NMAU | INV | OK**	INV	–	

Return for BER	Value range	Def. value	Def. unit	Unit ring
Total,	**PASS | FAIL | INV | TMER | IMP**	INV	–	
ClassIIBits,	**NMAU | INV | OK**	INV	–	
ClassIbBits,	**NMAU | INV | OK**	INV	–	
CRC	**NMAU | INV | OK**	INV	–	

Return for BBB	Value range	Def. value	Def. unit	Unit ring
ProgressTime,	**PASS | FAIL | INV | TMER | IMP**	INV	–	
ClassIIBits,	**NMAU | INV | OK**	INV	–	
CRCErrors	**NMAU | INV | OK**	INV	–	

Description of command	Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible error limits for the measured values of the bit error rate test (see command above) have been exceeded. The following messages can be output for the measured quantities:	all	≥2.00

PASS	all tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
INV	Invalid measurement	*invalid*
TMER	CMU could not synchronize	*too many errors*
IMP	Measurement impossible, therefore invalid	*impossible*
NMAU	Tolerance exceeded	*not matching, underflow*
INV	Invalid measurement	*invalid*
OK.	all tolerances matched	

Test Object Sensitivity – Continuous

The subsystem *SENSitivity:CONTinuous* contains the commands for sensitivity measurement with continuous repetition. The subsystem corresponds to the main menu *Sensitivity,* application *Continuous* and the corresponding parts of the associated popup menu *Sensitivity Configuration.*

Control of Measurement – Subsystem SENSitivity:CONTinuous

The subsystem *SENSitivity:CONTinuous* controls the *Continuous* measurement.

INITiate:SENSitivity:CONTinuous	Start new measurement	*RUN*
ABORt:SENSitivity:CONTinuous	Abort running measurement and switch off	*OFF*
STOP:SENSitivity:CONTinuous	Stop measurement	*STOP*
CONTinue:SENSitivity:CONTinuous	Next measurement step (only *stepping mode*)	*RUN*

Description of command	Status	FW vers.
These commands do not exist as queries. They start or stop the Continuous measurement, setting it to the status indicated in the top right column.	all	≥2.00

CONFigure: SENSitivity:CONTinuous:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	–
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			

Description of command	Status	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).	all	≥2.00

FETCh:SENSitivity:CONTinuous:STATus? Measurement Status

Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 500 |	Number of frames to average			
NONE	No averaging	NONE	–	–

Description of command	Status	FW vers.
This command is always a query. It returns the status of the measurement (see chapter 5).	all	≥2.00

Subsystem SENSitivity:CONTinuous:CONTrol

The subsystem *SENSitivity:CONTinuous:CONTrol* sets the parameters for the continuous sensitivity measurement. The subsystem corresponds to the index card *Control* in the popup menu *Sensitivity Configuration.*

CONFigure:SENSitivity:CONTinuous:CONTrol *<Mode>, <FramesToAverage>*

Meas. Mode, Average

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
RFER |	Residual bit error rate, FER	BER	–	
BER	Bit error rate			
BBB	Burst by Burst			
<FramesToAverage>	Description of parameters	Def. value	Def. unit	Unit ring
1 to 500 |	No. of frames to average	100	–	
OFF	No average (only 1 frame considered)			

Description of command	Status	FW vers.
This command defines the measured value and the number of frames to be averaged in the continuous measurement, constituting a statistics cycle. For definition of the measured value (BER, RBER etc.) see chapter 4.	all	≥2.00

CONFigure:SENSitivity:CONTinuous:CONTrol:REPetition *<StopCondition>* ,<Stepmode>

Stop Condition

<StopCondition>	Description of parameters	Def. value	Def. Unit	Unit ring
ALIMits |	Measurement aborted when all permissible limit values are violated	FLIM	–	–
FLIMit |	Aborted when first limit value is violated			
NONE	Not aborted, measurement over all frames			
<Stepmode>	Description of parameters	Def. value	Def. Unit	Unit ring
STEP |	Interrupt measurement after each statistics cycle	NONE	–	–
NONE	Continue measurement according to its rep. mode			

Description of command	Status	FW vers.
This command determines the stop condition and the stepping mode for the measurement.	all	≥2.00

CONFigure:SENSitivity:CONTinuous:CONTrol[:TCH]:LEVel:UTIMeslot *<Level>*

TCH BER Level, Used Timeslot

<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–137 dBm to –27 dBm	RF1 level in used timeslot	–102.0	dBm	Power level
–137 dBm to –10 dBm	RF2 level in used timeslot			
–90 dBm to +13 dBm	RF 3 OUT level in used timeslot			

Description of command	Status	FW vers.
This command defines the absolute level of the traffic channel (*TCH*) in the used timeslot for the continuous application. This level applies to the *Sensitivity* measurement only	all	≥2.00

CONFigure:SENSitivity:CONTinuous:CONTrol[:TCH]:LEVel:UNTimeslot *<Level>*
TCH BER Level, Unused Timeslot

<Level>	Description of parameters	Def. value	Def. unit	Unit ring
–127 dB to +127 dB	Level in unused timeslot	–18.0	dB	Ratio

Description of command	Status	FW vers.
This command defines the relative level of the traffic channel (*TCH*) in the unused timeslot for the continuous application. This level applies to the sensitivity measurement only. The value range mentioned above is valid provided that the sum of the absolute level of the used timeslot and the relative value for the unused timeslot does not exceed the value ranges for the absolute level of the used timeslot (for RF 1, RF 2 and RF 3 OUT).	all	≥2.00

CONFigure:SENSitivity:CONTinuous:CONTrol:DEFault
Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to default values The parameters partly or completely differ from the default value	ON	–	–

Description of command	Status	FW vers.
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* has no effect). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF).*	all	≥2.0

Subsystem SENSitivity:CONTinuous:LIMit

The subsystem *SENSitivity:CONTinuoust:LIMit* defines tolerance values for the continuous sensitivity measurement. The subsystem corresponds to the index card *Limits* in the popup menu *Sensitivity Configuration.*

CONFigure:SENSitivity:CONTinuous:LIMit:CLII *<ClassIIBER>*
Class II Bits

<ClassIIBER>	Description of parameters	Def. value	Def. unit	Unit ring
0 % to 100 %	Upper limit of error rate for class II bits	0.2	%	Ratio

Description of command	Status	FW vers.
This command defines an upper limit for the bit error rate of class II (unprotected bits, see chapter 4) for continuous application.		≥2.00

CONFigure:SENSitivity:CONTinuousLIMit:CLIB *<ClassIbBER>*
Class Ib Bits

<ClassIbBER>	Description of parameters	Def. value	Def. unit	Unit ring
0 % to 100 %	Upper limit of error rate for class Ib bits	0.4	%	Ratio

Description of command	Status	FW vers.
This command defines an upper limit for the bit error rate of class Ib (partly protected bits, see chapter 4) for the continuous application.		≥2.00

CONFigure:SENSitivity:CONTinuous:LIMit:FERRors <Frame Errors>				Frame Errors
<FERRors>	Description of parameters	Def. value	Def. unit	Unit ring
0 % to 100 %	Upper limit for erased frame errors	0.1	%	Ratio
Description of command			Status	FW vers.
This command defines an upper limit for the relative portion of invalid and therefore erased frames (*frame erasure rate*, see chapter 4) in the measurement of the residual bit error rate (*RBER*, see command `CONFigure:SENSitivity:CONTinuous:CONTrol`) and for the continuous application.				≥2.00

CONFigure:SENSitivity:CONTinuous:LIMit:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	Unit ring
ON | **OFF**	The parameters are set to default values The parameters partly or completely differ from the default value	ON	–	–
Description of command			Status	FW vers.
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* has no effect). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.			all	≥2.0

Measured Values – Subsystem SENSitivity:CONTinuous[:RESult]

The subsystem *SENSitivity:CONTinuous[:RESULT]* contains the commands for measurement and output of the bit error rate and its comparison with the tolerance values. The subsystem corresponds to the measurement menus *Sensitivity* for the continuous measurement.

READ[:SCALar]:SENSitivity:CONTinuous[:RESult]? Scalar Results: Start single shot measurement and return results

FETCh[:SCALar]: SENSitivity:CONTinuous[:RESult]? Read out results (unsynchronized)

SAMPle[:SCALar]: SENSitivity:CONTinuous[:RESult]? Read out results (synchronized)

Return for RFER	Value range	Def. value	Def. unit	Unit ring
ProgressTime,	0.0 to 100.0 %	NAN	%	
ClassIIBits,	0.000 to 100.000 %	NAN	%	
ClassIbBits,	0.000 to 100.000 %	NAN	%	
FER,	0.000 to 100.000 %	NAN	%	
CRCErrors,	1 to 50000	NAN	–	
Status	INV | PASS | FAIL | TMER | IMP	INV	–	
Return for BER	**Value range**	**Def. value**	**Def. unit**	**Unit ring**
ProgressTime,	0.0 to 100.0 %	NAN	%	
ClassIIBits,	0.000 to 100.000 %	NAN	%	
ClassIbBits,	0.000 to 100.000 %	NAN	%	
CRCErrors,	1 to 50000	NAN	–	
Status	INV | PASS | FAIL | TMER | IMP	INV	–	
Return for BBB	**Value range**	**Def. value**	**Def. unit**	**Unit ring**
ProgressTime,	0.0% to 100.0%	NAN	%	
ClassIIBits,	0.000% to 100.000%	NAN	%	
CRCErrors,	1 to 50000	NAN	–	
Status	INV | PASS | FAIL | TMER | IMP	INV	–	

Description of command	Status	FW vers.
These commands are always queries. They start a bit error rate test in the continuous repetition mode and output the measurement results (see also detailed explanation of measured values in chapter 4). The results depend on the measurement mode set via the `CONFigure:SENSitivity:CONTinuous<nr>:CONTrol` command (RFER, BER, or BBB). They are	all	≥2.20

ProgressTime	Relative progress of the measurement
ClassIIBits	(Residual) bit error rate for class II bits
ClassIbBits	(Residual) bit error rate for class Ib bits
FER	Frame erasure rate
CRCErrors	Cyclic redundancy check (CRC) errors
Status	Measurement status

The following messages can be output for the measurement status:

INV	Measurement invalid	*invalid*
PASS	All tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
TMER	CMU could not synchronize	*too many errors*
IMP	Measurement impossible, therefore invalid	*impossible*

CALCulate:SENSitivity:CONTinuous[:RESult]:LIMit:MATChing?				Limit Matching
Return for RBERFER	Value range	Def. value	Def. unit	Unit ring
Total,	**PASS | FAIL | INV | TMER | IMP**	INV	–	
ClassIIBits,	**NMAU | INV | OK**	INV	–	
ClassIbBits,	**NMAU | INV | OK**	INV	–	
FER,	**NMAU | INV | OK**	INV	–	
CRCErrors	**NMAU | INV | OK**	INV	–	
Return for BER	Value range	Def. value	Def. unit	Unit ring
Total,	**PASS | FAIL | INV | TMER | IMP**	INV	–	
ClassIIBits,	**NMAU | INV | OK**	INV	–	
ClassIbBits,	**NMAU | INV | OK**	INV	–	
CRC	**NMAU | INV | OK**	INV	–	
Return for BBB	Value range	Def. value	Def. unit	Unit ring
ProgressTime,	**PASS | FAIL | INV | TMER | IMP**	INV	–	
ClassIIBits,	**NMAU | INV | OK**	INV	–	
CRCErrors	**NMAU | INV | OK**	INV	–	
Description of command			Status	FW vers.
This command is always a query. It indicates whether and in which way the permissible error limits for the measured values of the bit error rate test (see command above) have been exceeded. The following messages can be output for the measured quantities:			all	≥2.00

PASS	all tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
INV	Invalid measurement	*invalid*
TMER	CMU could not synchronize	*too many errors*
IMP	Measurement impossible, therefore invalid	*impossible*
NMAU	Tolerance exceeded	*not matching, underflow*
INV	Invalid measurement	*invalid*
OK.	all tolerances matched	

List of Commands

In the following, all remote-control commands of the function group GSM900-MS implemented in the CMU will be listed with their parameters and page numbers. They are arranged alphabetically according to the **second** keyword of the command so that related commands belong to the same group. The commands for the operating modes with and without signalling are listed separately.

Commands for GSM Measurements without Signalling

Table 6-1 Remote-control commands: Non Signalling

Command	Parameter	Remark	Page
Inputs and outputs			
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to +50 dB	with query	6.8
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to +50 dB	with query	6.8
[SENSe:]CORRection:LOSS:Output<nr>[:MAGNitude]	-50 dB to 50 dB	with query	6.8
SOURce:CORRection:LOSS:Output<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.8
SOURce:DM:CLOCk:FREQuency	1.219 MHz to 39.000 MHz	with query	6.9
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.9
INPut[:STATe]	RF1 | RF2 | RF4	with query	6.7
OUTPut[:STATe]	RF1 | RF2 | RF3	–	6.7
Input and output level			
[SENSe:]LEVel:ATTenuation	NORMal | LNOise | LDIStortion	with query	6.2
[SENSe:]LEVel:DEFault	ON | OFF	with query	6.2
[SENSe:]LEVel:MAXimum	<Level>	with query	6.1
Modulation measurement			
INITiate:MODulation	–	no query	6.29
ABORt:MODulation	–	no query	6.29
STOP:MODulation	–	no query	6.29
CONTinue:MODulation	–	no query	6.29
CONFigure:SUBarrays:MODulation	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.33
CONFigure:MODulation:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.30
CONFigure:MODulation:CONTrol:DEFault	ON | OFF	with query	6.30
CONFigure:MODulation:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.30
CONFigure:MODulation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.29
CONFigure:MODulation:LIMit:DEFault	ON | OFF	with query	6.32
CONFigure:MODulation:LIMit:LOWer:AVERage	–50.0 deg to 0.0 deg, –50.0 deg to 0.0 deg, –1000 Hz to 0 Hz	with query	6.32

Command	Parameter	Remark	Page
CONFigure:MODulation:LIMit:LOWer:MODE	ON | OFF	with query	6.31
CONFigure:MODulation:LIMit:LOWer[:CURRent]	–50.0 deg to 0.0 deg, –50.0 deg to 0.0 deg, –1 kHz to 0 Hz	with query	6.31
CONFigure:MODulation:LIMit:UPPer:AVERage	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 1000 Hz	with query	6.32
CONFigure:MODulation:LIMit:UPPer:MODE	ON | OFF	with query	6.31
CONFigure:MODulation:LIMit:UPPer[:CURRent]	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 1 kHz	with query	6.31
FETCh:MODulation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.29
CALCulate:MODulation[:RESult]:LIMit:MATChing?	<Result>	query only	6.35
READ[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.34
FETCh[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.34
SAMPle[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.34
READ:ARRAy:MODulation[:RESult][:BURSt]:AVERage?	–100.0 dB to +100.0 dB	query only	6.35
FETCh:ARRAy:MODulation[:RESult][:BURSt]:AVERage?	–100.0 dB to +100.0 dB	query only	6.35
SAMPle:ARRAy:MODulation[:RESult][:BURSt]:AVERage?	–100.0 dB to +100.0 dB	query only	6.35
READ:SUBarrays:MODulation[:RESult][:BURSt]:AVERage?	–100.0 dB to +20.0 dB	query only	6.36
FETCh:SUBarrays:MODulation[:RESult][:BURSt]:AVERage?	–100.0 dB to +20.0 dB	query only	6.36
SAMPle:SUBarrays:MODulation[:RESult][:BURSt]:AVERage?	–100.0 dB to +20.0 dB	query only	6.36
READ:ARRAy:MODulation[:RESult][:BURSt]:MMAX?	–100.0 dB to +100.0 dB	query only	6.35
FETCh:ARRAy:MODulation[:RESult][:BURSt]:MMAX?	–100.0 dB to +100.0 dB	query only	6.35
SAMPle:ARRAy:MODulation[:RESult][:BURSt]:MMAX?	–100.0 dB to +100.0 dB	query only	6.35
READ:SUBarrays:MODulation[:RESult][:BURSt]:MMAX?	–100.0 dB to +20.0 dB	query only	6.36
FETCh:SUBarrays:MODulation[:RESult][:BURSt]:MMAX?	–100.0 dB to +20.0 dB	query only	6.36
SAMPle:SUBarrays:MODulation[:RESult][:BURSt]:MMAX?	–100.0 dB to +20.0 dB	query only	6.36
READ:ARRAy:MODulation[:RESult][:BURSt][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.35
FETCh:ARRAy:MODulation[:RESult][:BURSt][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.35
SAMPle:ARRAy:MODulation[:RESult][:BURSt][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.35
READ:SUBarrays:MODulation[:RESult][:BURSt][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.36
FETCh:SUBarrays:MODulation[:RESult][:BURSt][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.36
SAMPle:SUBarrays:MODulation[:RESult][:BURSt][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.36
FETCh:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.31
SAMPle:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.31
CALCulate:MODulation[:RESult]:LIMit:MATChing?	<Result>	query only	6.30
READ[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.29
FETCh[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.29
SAMPle[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.29

Command	Parameter	Remark	Page
Power vs Time and POWer:MPR measurement			
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.14
STOP:POWer[:NORMal][:GMSK]:MPR		no query	6.23
INITiate:POWer[:NORMal][:GMSK]	–	no query	6.12
ABORt:POWer[:NORMal][:GMSK]	–	no query	6.12
STOP:POWer[:NORMal][:GMSK]	–	no query	6.12
CONTinue:POWer[:NORMal][:GMSK]	–	no query	6.12
CONFigure:SUBarrays:POWer[:NORMal][:GMSK]	ALL | ARITHmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.18
CONFigure:POWer[:NORMal][:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.13
DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID	ON | OFF	with query	6.13
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.13
CONFigure:POWer[:NORMal][:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.12
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault	ON | OFF	with query	6.17
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>:MODE	ON | OFF	with query	6.17
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:NORMal]	<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>:MODE	ON | OFF	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:NORMal]	<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>	with query	6.15
INITiate:POWer[:NORMal][:GMSK]:MPR	–	no query	6.23
ABORt:POWer[:NORMal][:GMSK]:MPR	–	no query	6.23
CONTinue:POWer[:NORMal][:GMSK]:MPR	–	no query	6.23
CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.25
CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.24
CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.24
CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.23
FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.23
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.26

Command	Parameter	Remark	Page
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.27
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
CALCulate:POWer[:NORMal][:GMSK]:MPR[:RESult]:LIMit:MATChing?	<Result>	query only	6.28
READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?	<Result>	query only	6.26
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?	<Result>	query only	6.26
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?	<Result>	query only	6.26
FETCh:POWer[:NORMal][:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.12

Command	Parameter	Remark	Page
CONFigure:POWer[:NORMal][:GMSK]:TIME:MODE	GSM | OFFSet	with query	6.17
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:AVERage?	<Matching>	query only	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MAXimum?	<Matching>	query only	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MINimum?	<Matching>	query only	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing[:CURRent]?	<Matching>	query only	6.22
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.20
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.20
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.20
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.21
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.21
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 dB to +20.0 dB	query only	6.21
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.20
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.20
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.20
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.21
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.21
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB dB to +20.0 dB	query only	6.21
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.20
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.20
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.20
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.21
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.21
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.21
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.20
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.20
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt[:	–100.0 dB to +20.0 dB	query only	6.20

Command	Parameter	Remark	Page
CURRent]?			
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.21
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.21
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.21
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:AVERage?	MATC | NMAT | INV | NTSC | OUT	query only	6.21
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MAXimum?	MATC | NMAT | INV | NTSC | OUT	query only	6.21
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MINimum?	MATC | NMAT | INV | NTSC | OUT	query only	6.21
CALCulate[:SCALar]:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.20
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing[:CURRent]?	MATC | NMAT | INV | NTSC | OUT	query only	6.21
READ[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?	<Result>	query only	6.19
FETCh[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?	<Result>	query only	6.19
SAMPle[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?	AvgBurstPower, PeakBurstPower, BurstsOutOfTol, BurstMatching	query only	6.19
CONFigure:POWer[:NORMal][:GMSK]<nr>:LIMit:LINE:LOWer<nr>[:NORMal]:ENABle	ON | OFF	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]<nr>:LIMit:LINE:UPPer<nr>[:NORMal]:ENABle	ON | OFF	with query	6.15
CONFigure:POWer[:NORMal][:GMSK]<nr>:LIMit:LINE:LOWer<nr>[:NORMal]:ENABle	ON | OFF	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]<nr>:LIMit:LINE:UPPer<nr>[:NORMal]:ENABle	ON | OFF	with query	6.15
Signals received			
[SENSe:]RFANalyzer:CHANnel	0.2 MHz to 2700 MHz	with query	6.4
[SENSe:]RFANalyzer:FREQuency:OFFSet	–10 kHz to 10 kHz	with query	6.4
[SENSe:]RFANalyzer:TSEQuence	OFF | GSM0 to GSM7 | DUMMy	with query	6.4
Signals generated			
INITiate:RFGenerator	–	no query	6.5
ABORt:RFGenerator	–	no query	6.5
SOURce:RFGenerator:FM:DEViation	–10 kHz to 10 kHz	with query	6.6
SOURce:RFGenerator:FREQuency:CHANnel	0.2 MHz to 2700 MHz	with query	6.6
SOURce:RFGenerator:LEVel:UNTimeslot	<Level>	with query	6.5
SOURce:RFGenerator:LEVel:UTIMeslot	<Level>	with query	6.5
CONFigure:RFGenerator:MODulation:BIT:SELection	OFF | PRBS | DUMMybursts	with query	6.6
CONFigure:RFGenerator:MODulation:TRANsmission	BURSt | CONTinuous	with query	6.7
CONFigure:RFGenerator:MODulation:TSEQuence:SELection	OFF | GSM0 to GSM7 | DUMMy	with query	6.7

Command	Parameter	Remark	Page
FETCh:RFGenerator:STATus?	OFF | RUN | ERR	query only	6.5
Speech codec			
ROUTe:SPDecoder[:INPut]	HANDset | ANALyzer | AUX2	with query	6.8
ROUTe:SPENcoder[:INPut]	HANDset | GENerator | AUX1	with query	6.8
Spectrum due to modulation measurements			
INITiate:SPECtrum:MODulation	–	no query	6.37
ABORt:SPECtrum:MODulation	–	no query	6.37
STOP:SPECtrum:MODulation	–	no query	6.37
CONTinue:SPECtrum:MODulation	–	no query	6.37
CONFigure:SUBarrays:SPECtrum:MODulation	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.42
SAMPle[:SCALar]:SPECtrum:MODulation [:RESult]?	–100 dBm to 50 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.43
CONFigure:SPECtrum:MODulation:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.38
CONFigure:SPECtrum:MODulation:CONTrol:DEFault	ON | OFF	with query	6.39
DISPlay:SPECtrum:MODulation:CONTrol:GRID	ON | OFF	with query	6.38
CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle	ON | OFF	with query	6.39
CONFigure:SPECtrum:MODulation:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.38
CONFigure:SPECtrum:MODulation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.37
CONFigure:SPECtrum:MODulation:LIMit:LINE:DEFault	ON | OFF	with query	6.42
CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer]	ON | OFF	with query	6.41
CONFigure:SPECtrum:MODulation:LIMit:LINE:REFPower	0 dBm to 43 dBm, 0 dBm to 43 dBm	with query	6.41
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>	–99.9 dB to 99.9 dB, –99.9 dB to 99.9 dB, –100 dBm to +30 dBm, ON | OFF	with query	6.40
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>:ENABle	ON | OFF	with query	6.40
FETCh:SPECtrum:MODulation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.37
READ[:SCALar]:SPECtrum:MODulation[:RESult]?	–100 dBm to 50 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.43
FETCh[:SCALar]:SPECtrum:MODulation[:RESult]?	–100 dBm to 50 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.43
READ:ARRAy:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44
FETCh:ARRAy:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44
SAMPle:ARRAy:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44
READ:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44
FETCh:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44
FETCh:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44

Command	Parameter	Remark	Page
SAMPle:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.44
Spectrum due to switching measurements			
INITiate:SPECtrum:SWITching	–	no query	6.45
ABORt:SPECtrum:SWITching	–	no query	6.45
STOP:SPECtrum:SWITching	–	no query	6.45
CONTinue:SPECtrum:SWITching	–	no query	6.45
CONFigure:SUBarrays:SPECtrum:SWITching	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.50
SAMPle[:SCALar]:SPECtrum:SWITching [:RESult]?	–100 dBm to 20 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.51
CONFigure:SPECtrum:SWITching:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.46
CONFigure:SPECtrum:SWITching:CONTrol:DEFault	ON | OFF	with query	6.47
DISPlay:SPECtrum:SWITching:CONTrol:GRID	ON | OFF	with query	6.46
CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle	ON | OFF	with query	6.47
CONFigure:SPECtrum:SWITching:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.46
CONFigure:SPECtrum:SWITching:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.45
CONFigure:SPECtrum:SWITching:LIMit:LINE:DEFault	ON | OFF	with query	6.50
CONFigure:SPECtrum:SWITching:LIMit:LINE:ENABle[:UPPer]	ON | OFF	with query	6.49
CONFigure:SPECtrum:SWITching:LIMit:LINE:MODE[:UPPer]	ON | OFF	with query	6.49
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr>	<PowerLevel>,<Limit at 0.4 MHz>,<Limit at 0.6 MHz>,<Limit at 1.2 MHz>,<Limit at 1.8 MHz>,<Enable>	with query	6.48
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr>:ENABle	ON | OFF	with query	6.48
FETCh:SPECtrum:SWITching:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.45
READ[:SCALar]:SPECtrum:SWITching[:RESult]?	–100 dBm to 20 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.51
FETCh[:SCALar]:SPECtrum:SWITching[:RESult]?	–100 dBm to 20 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.51
READ:ARRAy:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.52
FETCh:ARRAy:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.52
SAMPle:ARRAy:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.52
READ:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.52
FETCh:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.52
SAMPle:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.52
Measured wide band power			
INITiate:SPOWer	–	no query	6.10

Command	Parameter	Remark	Page
ABORt:SPOWer	–	no query	6.10
STOP:SPOWer	–	no query	6.10
CONTinue:SPOWer	–	no query	6.10
CONFigure:SPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.11
CONFigure:SPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.10
FETCh:SPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 ... 10000 | NONE	query only	6.10
READ[:SCALar]:SPOWer[:RESult]?	–30 dBm to +30 dBm	query only	6.11
FETCh[:SCALar]:SPOWer[:RESult]?	–30 dBm to +30 dBm	query only	6.11
SAMPle[:SCALar]:SPOWer[:RESult]?	–30 dBm to +30 dBm	query only	6.11
Trigger			
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.3
TRIGger[:SEQuence]:SOURce	IMMediate | RFPower | IFPower | EXTern	with query	6.2
TRIGger[:SEQuence]:THReshold	LOW | MEDium | HIGH	with query	6.3

Commands for GSM Measurements with Signalling

Table 6-2 Remote-control commands: Signalling mode

Command	Parameter	Remark	Page
RF generator signal of CMU			
CONFigure:BSSignal:CCH:CHANnel	<Channel>	with query	6.58
CONFigure:BSSignal:CCH:LEVel[:ABSolute]	<Level>	with query	6.58
CONFigure:BSSignal:FM:DEViation	–100 kHz to +100 kHz	with query	6.61
CONFigure:BSSignal:SPEech	ECHO | LOOP | PR9 | PR11 | PR15 | PR16 | HANDset	with query	6.61
PROCedure:BSSignal:SPEech	ECHO | LOOP | PR9 | PR11 | PR15 | PR16 | HANDset	with query	6.61
PROCedure:BSSignal:TIMing:ADVance	0 bit to 63 bit	with query	6.60
CONFigure:BSSignal:TIMing:ADVance	0 bit to 63 bit	with query	6.60
CONFigure:BSSignal[:TCH]:CHANnel	<TCHChannel>	with query	6.59
CONFigure:BSSignal[:TCH]:FHOPping:A	<Channel>{,<Channel>}	with query	6.59
CONFigure:BSSignal[:TCH]:FHOPping:B	Channel>{,<Channel>}	with query	6.59
CONFigure:BSSignal[:TCH]:FHOPping:C	Channel>{,<Channel>}	with query	6.59
CONFigure:BSSignal[:TCH]:FHOPping:D	Channel>{,<Channel>}	with query	6.59
PROCedure:BSSignal[:TCH]:FHOPping:SEQuence	A | B | C | D | OFF	with query	6.59
CONFigure:BSSignal[:TCH]:LEVel:UNTimeslot	<Level>	with query	6.61
PROCedure:BSSignal[:TCH]:LEVel:UNTimeslot	<Level>	with query	6.61
CONFigure:BSSignal[:TCH]:LEVel:UTIMeslot	<Level>	with query	6.60
PROCedure:BSSignal[:TCH]:LEVel:UTIMeslot	<Level>	with query	6.60
CONFigure:BSSignal[:TCH]:TIMeslot	2 to 6	with query	6.60
Inputs and Outputs			
[SENSe:]:CORRection:LOSS:INPut<nr>[:MAGNitude]	-50 dB to 50 dB	with query	6.69
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]	-50 dB to 50 dB	with query	6.69
[SENSe:]CORRection:LOSS:Output<nr>[:MAGNitude]	-50 dB to 50 dB	with query	6.69
SOURce:CORRection:LOSS:Output<nr>[:MAGNitude]	-50 dB to 50 dB	with query	6.69
SOURce:DM:CLOCk:FREQuency	1.2190 MHz to 39.000 MHz	with query	6.70
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.70
INPut[:STATe]	RF1 | RF2 | RF4	with query	6.69
[SENSe:]LEVel:ATTenuation	NORMal | LNOise | LDIStortion	with query	6.53
[SENSe:]LEVel:DEFault	ON | OFF	with query	6.54
[SENSe:]LEVel:MAXimum	<Level>	with query	6.53
[SENSe:]LEVel:MODE	MANual | PCLevel | AUTO	with query	6.53
OUTPut[:STATe]	RF1 | RF2 | RF3	with query	6.69
Handover			

Command	Parameter	Remark	Page
CONFigure:HANDover:TARGet	<Target>	with query	6.58
STATus:HANDover:TARGet:LIST?	<List>	query only	6.58
Frequency and phase errors			
INITiate:MODulation	–	no query	6.97
ABORt:MODulation	–	no query	6.97
STOP:MODulation	–	no query	6.97
CONTinue:MODulation	–	no query	6.97
CONFigure:SUBarrays:MODulation	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.100
CONFigure:MODulation:CONTrol	SCALar | ARRay, 1 to 1000 | OFF	with query	6.98
CONFigure:MODulation:CONTrol:DEFault	ON | OFF	with query	6.99
CONFigure:MODulation:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE	with query	6.98
CONFigure:MODulation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.97
CONFigure:MODulation:LIMit:AVERage	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 1 kHz	with query	6.99
CONFigure:MODulation:LIMit:DEFault	ON | OFF	with query	6.100
CONFigure:MODulation:LIMit:LOWer:MODE	ON | OFF	with query	6.100
CONFigure:MODulation:LIMit:UPPer:MODE	ON | OFF	with query	6.99
CONFigure:MODulation:LIMit[:CURRent]	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 1 kHz	with query	6.99
FETCh:MODulation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.97
READ:SUBarrays:MODulation[:RESult]:[:BURSt]AVERage?	–100.0 to +20.0	query only	6.102
FETCh:SUBarrays:MODulation[:RESult]:[:BURSt]AVERage?	–100.0 to +20.0	query only	6.102
SAMPle:SUBarrays:MODulation[:RESult]:[:BURSt]AVERage?	–100.0 to +20.0	query only	6.102
READ:ARRAy:MODulation[:RESult]:[:BURSt]AVERage?	–100.0 to +20.0	query only	6.103
FETCh:ARRAy:MODulation[:RESult]:[:BURSt]AVERage?	–100.0 to +20.0	query only	6.103
SAMPle:ARRAy:MODulation[:RESult]:[:BURSt]AVERage?	–100.0 to +20.0	query only	6.103
READ:SUBarrays:MODulation[:RESult]:[:BURSt]MMAX?	–100.0 to +20.0	query only	6.102
FETCh:SUBarrays:MODulation[:RESult]:[:BURSt]MMAX?	–100.0 to +20.0	query only	6.102
SAMPle:SUBarrays:MODulation[:RESult]:[:BURSt]MMAX?	–100.0 dB to +20.0 dB	query only	6.102
READ:ARRAy:MODulation[:RESult]:[:BURSt]MMAX?	–100.0 to +20.0	query only	6.103
FETCh:ARRAy:MODulation[:RESult]:[:BURSt]MMAX?	–100.0 to +20.0	query only	6.103
SAMPle:ARRAy:MODulation[:RESult]:[:BURSt]MMAX?	–100.0 dB to +20.0 dB	query only	6.103
READ:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.102
FETCh:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.102
SAMPle:SUBarrays:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.102
FETCh:ARRAy:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.103

Command	Parameter	Remark	Page
SAMPle:ARRAy:MODulation[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.103
CALCulate:MODulation[:RESult]:LIMit:MATChing?	<Result>	query only	6.103
READ[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.101
FETCh[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.101
SAMPle[:SCALar]:MODulation[:RESult]?	<Result>	query only	6.101
Parameters of the mobile phone			
[SENSe:]MSSinfo:DNUMber?	Max. 20-digit	query only	6.73
[SENSe:]MSSInfo:IMEI:FAC?	2-digit | NAN	query only	6.72
[SENSe:]MSSInfo:IMEI:SNR?	6-digit | NAN	query only	6.72
[SENSe:]MSSInfo:IMEI:SVN?	1 | 2-digit | NAN	query only	6.72
[SENSe:]MSSInfo:IMEI:TAC?	6-digit | NAN	query only	6.72
[SENSe:]MSSInfo:IMSI:MCC?	0 to 999 | NAN	query only	6.72
[SENSe:]MSSInfo:IMSI:MNC?	0 to 99 | NAN	query only	6.72
[SENSe:]MSSInfo:IMSI:MSIN?		6.72	
[SENSe:]MSSinfo:POWer:CLASs?	1 to 5	query only	6.73
[SENSe:]MSSInfo:REVision?	PH1 | PH2 | PH2P	query only	6.72
[SENSe:]MSSinfo:TRAFfic?	FRV1 | FRV2 | HRV1 | FD24 | FD48 | FD96 | FD14 | HD24 | HD48	query only	6.73
Network parameters			
CONFigure:NETWork:AOCHarge	<Value1>, <Value2> ... , <Value7>	with query	6.62
CONFigure:NETWork:AOCharge:ENABle	ON | OFF		6.62
CONFigure:NETWork:BAList	<Channel> {,<Channel>}	with query	6.62
CONFigure:NETWork:IDENtity:BCC	0 to 7	with query	6.66
CONFigure:NETWork:IDENtity:LAC	0 to 65535	with query	6.66
CONFigure:NETWork:IDENtity:MCC	0 to 999	with query	6.66
CONFigure:NETWork:IDENtity:MNC	0 to 99	with query	6.66
CONFigure:NETWork:IDENtity:NCC	0 to 7	with query	6.66
CONFigure:NETWork:REQuest:AUTHenticate	ON | OFF	with query	6.63
CONFigure:NETWork:REQuest:HANDover	ON | OFF	with query	6.63
CONFigure:NETWork:REQuest:IMEI	ON | OFF	with query	6.63
CONFigure:NETWork:REQuest:IMSI	ON | OFF	with query	6.62
CONFigure:NETWork:SMODe:IMSI:MCC	0 to 999	with query	6.64
CONFigure:NETWork:SMODe:IMSI:MNC	0 to 99	with query	6.64
CONFigure:NETWork:SMODe:IMSI:MSIN		6.64	
CONFigure:NETWork:SMODe:LCOMmand	ENABle | DISable | BER	with query	6.65
CONFigure:NETWork:SMODe:LOCupdate	ALWays | AUTO	with query	6.64
CONFigure:NETWork:SMODe:PCHange	FAST | SLOW	with query	6.65
CONFigure:NETWork:SMODe:SCHannel	SDCCh | FACCh | NONE	with query	6.65

Command	Parameter	Remark	Page
CONFigure:NETWork:SMODe:STIMe	0 to 600 | OFF	with query	6.66
CONFigure:NETWork:SMODe:TRAFfic	FRV1 | FRV2 | HRV1 | FD24 | FD48 | FD96 | FD14 | HD24 | HD48	with query	6.65
CONFigure:NETWork:SYSTem:BSAGblksres	0 to 7	with query	6.67
CONFigure:NETWork:SYSTem:BSPamfrms	2 to 9	with query	6.67
CONFigure:NETWork:SYSTem:BSPReorganis	ON|OFF	with query	6.67
CONFigure:NETWork:SYSTem:CACCess	BARRed | NBARRed	with query	6.67
CONFigure:NETWork:TIMeout:MTC	0 s to 60 s | OFF	with query	6.68
CONFigure:NETWork:TIMeout:RLINk:TESTset	4 to 64 | OFF	with query	6.68
CONFigure:NETWork:TIMeout:RLINk[:MOBile]	4 to 64	with query	6.68
CONFigure:NETWork[:MS]:DTX	ON | OFF	with query	6.63
CONFigure:NETWork[:MS]:POWer	<Level>	with query	6.64
Power vs time, power vs PCL, and POWer:MGR measurements (normal burst)			
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.78
STOP:POWer[:NORMal][:GMSK]:MPR	–	no query	6.91
CONFigure:POWer:LIMit:ABPower<nr>	<StartPCL>, <StopPCL>, <LowerLimit>, <UpperLimit>	with query	6.82
INITiate:POWer:PCL	–	no query	6.88
ABORt:POWer:PCL	–	no query	6.88
STOP:POWer:PCL	–	no query	6.88
CONTinue:Power:PCL	–	no query	6.88
CONFigure:POWer:PCL:CHANnel	<Channel1>,<Channel2>,<Channel3>	with query	6.89
CONFigure:POWer:PCL:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.89
CONFigure:POWer:PCL:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.88
FETCh:POWer:PCL:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.88
CALCulate[:SCALar]:POWer:PCL[:RESult]:LIMit:MATChing?	OK | NMAU | NMAL | INV	query only	6.90
READ[:SCALar]:POWer:PCL[:RESult]?	<Result>	query only	6.90
FETCh[:SCALar]:POWer:PCL[:RESult]?	<Result>	query only	6.90
SAMPle[:SCALar]:POWer:PCL[:RESult]?	<Result>	query only	6.90
INITiate:POWer[:NORMal][:GMSK]	–	no query	6.76
ABORt:POWer[:NORMal][:GMSK]	–	no query	6.76
STOP:POWer[:NORMal][:GMSK]	–	no query	6.76
CONTinue:POWer[:NORMal][:GMSK]	–	no query	6.76
CONFigure:SUBarrays:POWer[:NORMal][:GMSK]	ALL | ARIThmetical | MINimum | MAXimum,<Range_1>, ..., <Range_n>	with query	6.83
CONFigure:POWer[:NORMal][:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 |	with query	6.77

Command	Parameter	Remark	Page
	OFF		
DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID	ON | OFF	with query	6.77
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.77
CONFigure:POWer[:NORMal][:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.76
CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr>	<StartPCL>,<StopPCL>,<LowerLimit>,<UpperLimit>	with query	6.82
CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr>[:ENABle]	ON | OFF	with query	6.82
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault	ON | OFF	with query	6.82
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer:ALL:DYNamic:ENABle	ON | OFF	with query	6.82
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer[:STATic]:MODE	ON | OFF	with query	6.80
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>:DYNamic:ENABle	ON | OFF	with query	6.81
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>:DYNamic<RgNr>	<fromPCL>, <toPCL>, <Correction>, ON | OFF	with query	6.81
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]	<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>	with query	6.79
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic][:ENABle]	ON | OFF	with query	6.79
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]	<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>	with query	6.78
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]:ENABle	ON | OFF	with query	6.78
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]:MODE	ON | OFF	with query	6.80
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE[:UPPer]:ALL:DYNamic:ENABle	ON | OFF	with query	6.81
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE[:UPPer]<nr>:DYNamic	<fromPCL>, <toPCL>, <Correction>, ON | OFF	with query	6.80
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE[:UPPer]<nr>:DYNamic:ENABle	ON | OFF	with query	6.81
INITiate:POWer[:NORMal][:GMSK]:MPR	–	no query	6.91
ABORt:POWer[:NORMal][:GMSK]:MPR	–	no query	6.91
CONTinue:POWer[:NORMal][:GMSK]:MPR	–	no query	6.91
CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.93
CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.92
CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror |	with query	6.92

Command	Parameter	Remark	Page
	NONE,STEP | NONE		
CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.91
FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.91
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.94
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.94
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.94
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.95
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.95
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.95
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.94
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.94
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.94
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.95
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.95
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.95
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.94
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.94
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.94
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.95
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.95
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.95
READ:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.94
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.94
SAMPle:ARRAy:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.94
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.95
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.95

Command	Parameter	Remark	Page
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.95
CALCulate:POWer[:NORMal][:GMSK]:MPR[:RESult]:LIMit:MATChing?	<Result>	query only	6.96
READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?	<Result>	query only	6.94
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?	<Result>	query only	6.94
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR[:RESult]?	<Result>	query only	6.94
FETCh:POWer[:NORMal][:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.76
CONFigure:POWer[:NORMal][:GMSK]:TIME:MODE	GSM | OFFSet	with query	6.83
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:AVERage?	<Matching>	query only	6.87
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MAXimum?	<Matching>	query only	6.87
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MINimum?	<Matching>	query only	6.87
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing[:CURRent]?	<Matching>	query only	6.87
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.85
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.85
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.85
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.86
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.86
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:AVERage?	–100.0 to +20.0	query only	6.86
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.85
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.85
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.85
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.86
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 to +20.0	query only	6.86
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MAXimum?	–100.0 dB to +20.0 dB	query only	6.86
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.85
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.85
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.85
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINi	–100.0 to +20.0	query only	6.86

Command	Parameter	Remark	Page
mum?			
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 to +20.0	query only	6.86
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt:MINimum?	–100.0 dB to +20.0 dB	query only	6.86
READ:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.85
FETCh:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.85
SAMPle:ARRAy:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.85
READ:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.86
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.86
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:RESult]:BURSt[:CURRent]?	–100.0 to +20.0	query only	6.86
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:AVERage?	<Matching>	query only	6.86
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MAXimum?	<Matching>	query only	6.86
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MINimum?	<Matching>	query only	6.86
CALCulate[:SCALar]:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.86
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing[:CURRent]?	<Matching>	query only	6.86
READ[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?	<Result>	query only	6.84
FETCh[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?	<Result>	query only	6.84
SAMPle[:SCALar]:POWer[:NORMal][:GMSK][:RESult]?	<Result>	query only	6.84
MS Receiver Reports			
[SENSe:]RREPorts:COUNt?	<Counts>	query only	6.71
[SENSe:]RREPorts:DTX?	ON | OFF	query only	6.71
[SENSe:]RREPorts:NCELl?	<Channel>, 0 to 63 | NAN	query only	6.71
[SENSe:]RREPorts:RXLevel?	0 to 63 | NAN	query only	6.71
[SENSe:]RREPorts:RXQuality?	0 to 7 | NAN	query only	6.71
Sensitivity measurements			
INITiate:SENSitivity:CONTinuous	–	no query	6.128
ABORt:SENSitivity:CONTinuous	–	no query	6.128
STOP:SENSitivity:CONTinuous	–	no query	6.128
CONTinue:SENSitivity:CONTinuous	–	no query	6.128
CONFigure:SENSitivity:CONTinuous:CONTrol	RFER | BER | BBB, 1 to 500 | OFF	with query	6.129

Command	Parameter	Remark	Page
CONFigure:SENSitivity:CONTinuous:CONTrol:DEFault	ON | OFF	with query	6.130
CONFigure:SENSitivity:CONTinuous:CONTrol:REPetition	FLIMit | ALIMits | NONE, STEP | NONE	with query	6.129
CONFigure:SENSitivity:CONTinuous:CONTrol[:TCH]:LEVel:UNTimeslot	–127 dB to +127 dB	with query	6.130
CONFigure:SENSitivity:CONTinuous:CONTrol[:TCH]:LEVel:UTIMeslot	<Level>	with query	6.129
CONFigure:SENSitivity:CONTinuous:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.128
CONFigure:SENSitivity:CONTinuous:LIMit:CLIB	0 % to 100 %	with query	6.130
CONFigure:SENSitivity:CONTinuous:LIMit:CLII	0 % to 100 %	with query	6.130
FETCh:SENSitivity:CONTinuous:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 500 | NONE	query only	6.128
CALCulate:SENSitivity:CONTinuous[:RESult]:LIMit:MATChing?	<Result>	query only	6.133
READ[:SCALar]:SENSitivity:CONTinuous[:RESult]?	<Result>	query only	6.132
FETCh[:SCALar]:SENSitivity:CONTinuous[:RESult]?	<Result>	query only	6.132
SAMPle[:SCALar]:SENSitivity:CONTinuous[:RESult]?	<Result>	query only	6.132
CONFigure:SENSitivity:CONTinuousLIMit:DEFault	ON | OFF	with query	6.131
CONFigure:SENSitivity:CONTinuousLIMit:FERRors	0 % to 100 %	with query	6.131
CONFigure:SENSitivity:CONTrol:DEFault	ON | OFF	with query	6.120
CONFigure:SENSitivity:CONTrol:HTIMe	0 s to 100 s, 0 s to 100 s	with query	6.120
INITiate:SENSitivity:SSHot	–	no query	6.121
ABORt:SENSitivity:SSHot	–	no query	6.121
STOP:SENSitivity:SSHot	–	no query	6.121
CONTinue:SENSitivity:SSHot	–	no query	6.121
CONFigure:SENSitivity:SSHot:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.121
FETCh:SENSitivity:SSHot:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 50000 | NONE	query only	6.122
CONFigure:SENSitivity:SSHot:TSETup	TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS8 | TS9 | TS10	with query	6.121
CALCulate:SENSitivity:SSHot[:RESult]:LIMit:MATChing?	<Result>	query only	6.127
READ[:SCALar]:SENSitivity:SSHot[:RESult]?	<Result>	query only	6.126
FETCh[:SCALar]:SENSitivity:SSHot[:RESult]?	<Result>	query only	6.126
SAMPle[:SCALar]:SENSitivity:SSHot[:RESult]?	<Result>	query only	6.126
CONFigure:SENSitivity:SSHot<nr>:CONTrol	RFER | BER | BBBurst | RUFR | RESidr | REVSidr, 1 to 50000 | NONE	with query	6.122
CONFigure:SENSitivity:SSHot<nr>:CONTrol:DEFault	ON | OFF	with query	6.124
CONFigure:SENSitivity:SSHot<nr>:CONTrol:REPetition	ALIMits | FLIMit | NONE, STEP | NONE	with query	6.123
CONFigure:SENSitivity:SSHot<nr>:CONTrol[:TCH]:LEVel:UNTimeslot	–127 dB to +127 dB	with query	6.123
CONFigure:SENSitivity:SSHot<nr>:CONTrol[:TCH]:LEVel:UTIMeslot	<Level>	with query	6.123
CONFigure:SENSitivity:SSHot<nr>:LIMit:CLIB	0 % to 100 %	with query	6.124

Command	Parameter	Remark	Page
CONFigure:SENSitivity:SSHot<nr>:LIMit:CLII	0 % to 100 %	with query	6.124
CONFigure:SENSitivity:SSHot<nr>:LIMit:DEFault	ON | OFF	with query	6.125
CONFigure:SENSitivity:SSHot<nr>:LIMit:FERRors	0 % to 100 %	with query	6.124
Signalling			
PROCedure:SIGNalling:ACTion	SOFF | SON | MTC | SMS | CRELease | HANDover	with query	6.55
PROCedure:SIGNalling:CHCCombined	<ChannelNumber>, <Timeslot>, <PCL>	with query	6.56
PROCedure:SIGNalling:MS:PCL	0 to 31	with query	6.57
[SENSe:]SIGNalling:SMS?	<Text>	query only	6.57
[SENSe:]SIGNalling:STATe?	SOFF | SON | SYNC | CEST | CPEN | CED	query only	6.56
PROCedure:SIGNalling[:TCH]:CHANnel	<Number>	with query	6.57
PROCedure:SIGNalling[:TCH]:FHOPping:SEQuence	A | B | C | D | OFF	with query	6.57
PROCedure:SIGNalling[:TCH]:TIMeslot	2 to 6	with query	6.57
CONFigure:SIGNallingSMS	<Text>	with query	6.57
Speech Codec			
ROUTe:SPDecoder[:INPut]	HANDset | ANALyzer | AUX2	with query	6.70
ROUTe:SPENcoder[:INPut]	HANDset | GENerator | AUX1	with query	6.70
Spectrum due to modulation measurements			
INITiate:SPECtrum:MODulation	–	no query	6.104
ABORt:SPECtrum:MODulation	–	no query	6.104
STOP:SPECtrum:MODulation	–	no query	6.104
CONTinue:SPECtrum:MODulation	–	no query	6.104
CONFigure:SUBarrays:SPECtrum:MODulation	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.109
SAMPle[:SCALar]:SPECtrum:MODulation [:RESult]?	–100 dBm to 50 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.110
CONFigure:SPECtrum:MODulation:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.105
CONFigure:SPECtrum:MODulation:CONTrol:DEFault	ON | OFF	with query	6.106
DISPlay:SPECtrum:MODulation:CONTrol:GRID	ON | OFF	with query	6.105
CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle	ON | OFF	with query	6.106
CONFigure:SPECtrum:MODulation:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.105
CONFigure:SPECtrum:MODulation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.104
CONFigure:SPECtrum:MODulation:LIMit:LINE:DEFault	ON | OFF	with query	6.109
CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer]	ON | OFF	with query	6.108

Command	Parameter	Remark	Page
CONFigure:SPECtrum:MODulation:LIMit:LINE:REFPower	0 dBm to 43 dBm, 0 dBm to 43 dBm	with query	6.108
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>	–99.9 dB to 99.9 dB, –99.9 dB to 99.9 dB, –100 dBm to +30 dBm, ON | OFF	with query	6.107
CONFigure:SPECtrum:MODulation:LIMit:LINE[:UPPer]<nr>:ENABle	ON | OFF	with query	6.107
FETCh:SPECtrum:MODulation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.104
READ[:SCALar]:SPECtrum:MODulation[:RESult]?	–100 dBm to 50 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.110
FETCh[:SCALar]:SPECtrum:MODulation[:RESult]?	–100 dBm to 50 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.110
READ:ARRAy:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.111
FETCh:ARRAy:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.111
SAMPle:ARRAy:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.111
READ:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.111
FETCh:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.111
SAMPle:SUBarrays:SPECtrum:MODulation[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.111
Spectrum due to switching measurements			
INITiate:SPECtrum:SWITching	–	no query	6.112
ABORt:SPECtrum:SWITching	–	no query	6.112
STOP:SPECtrum:SWITching	–	no query	6.112
CONTinue:SPECtrum:SWITching	–	no query	6.112
CONFigure:SUBarrays:SPECtrum:SWITching	ALL | ARIThmetical | MINimum | MAXimum,<Range>{,<Range>}	with query	6.117
SAMPle[:SCALar]:SPECtrum:SWITching [:RESult]?	–100 dBm to 20 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.118
CONFigure:SPECtrum:SWITching:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.113
CONFigure:SPECtrum:SWITching:CONTrol:DEFault	ON | OFF	with query	6.114
DISPlay:SPECtrum:SWITching:CONTrol:GRID	ON | OFF	with query	6.113
CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle	ON | OFF	with query	6.114
CONFigure:SPECtrum:SWITching:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.113
CONFigure:SPECtrum:SWITching:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.112
CONFigure:SPECtrum:SWITching:LIMit:LINE:DEFault	ON | OFF	with query	6.117
CONFigure:SPECtrum:SWITching:LIMit:LINE:ENABle[:UPPer]	ON | OFF	with query	6.116
CONFigure:SPECtrum:SWITching:LIMit:LINE:MODE[:UPPer]	ON | OFF	with query	6.116
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr>	<PowerLevel>,<Limit at 0.4	with query	6.115

Command	Parameter	Remark	Page
	MHz>,<Limit at 0.6 MHz>,<Limit at 1.2 MHz>,<Limit at 1.8 MHz>,<Enable>		
CONFigure:SPECtrum:SWITching:LIMit:LINE[:UPPer]<nr>:ENABle	ON | OFF	with query	6.115
FETCh:SPECtrum:SWITching:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.112
READ[:SCALar]:SPECtrum:SWITching[:RESult]?	–100 dBm to 20 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.118
FETCh[:SCALar]:SPECtrum:SWITching[:RESult]?	–100 dBm to 20 dBm, INV | MATC | NMAT | OUT | NTR | BNF | OFF	query only	6.118
READ:ARRAy:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.118
FETCh:ARRAy:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.118
SAMPle:ARRAy:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.118
READ:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.119
FETCh:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.119
FETCh:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.119
SAMPle:SUBarrays:SPECtrum:SWITching[:RESult]?	–100.0 dB to +20.0 dB, ...	query only	6.119
Signalling power measurements			
INITiate:SPOWer	–	no query	6.74
ABORt:SPOWer	–	no query	6.74
STOP:SPOWer	–	no query	6.74
CONTinue:SPOWer	–	no query	6.74
CONFigure:SPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.75
CONFigure:SPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.74
FETCh:SPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.74
READ[:SCALar]:SPOWer[:RESult]?	–30 dBm to 30 dBm	query only	6.75
FETCh[:SCALar]:SPOWer[:RESult]?	–30 dBm to 30 dBm	query only	6.75
SAMPle[:SCALar]:SPOWer[:RESult]?	–30 dBm to 30 dBm	query only	6.75
Trigger			
TRIGger[:SEQuence]: THReshold	LOW | MEDium | HIGH	with query	6.54
TRIGger[:SEQuence]:SOURce	SIGNalling | FRUN | RFPower | IFPower	with query	6.54
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.54

Alphabetical Command Lists

Table 6-3 Remote-control commands: *Non Signalling* mode

Command (Non Signalling, alphabetical)	**Page**
ABORt:MODulation	6.29
ABORt:POWer[:NORMal][:GMSK]	6.12
ABORt:POWer[:NORMal][:GMSK]:MPR	6.23
ABORt:RFGenerator	6.5
ABORt:SPECtrum:MODulation	6.37
ABORt:SPECtrum:SWITching	6.45
ABORt:SPOWer	6.10
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:AVERage?	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MAXimum?	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing:MINimum?	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:AREA:LIMit:MATChing[:CURRent]?	6.22
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:AVERage?	6.21
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MAXimum?	6.21
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing:MINimum?	6.21
CALCulate:ARRay:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing[:CURRent]?	6.21
CALCulate:MODulation[:RESult]:LIMit:MATChing?	6.35
CALCulate:POWer[:NORMal][:GMSK]:MPR[:RESult]:LIMit:MATChing?	6.28
CALCulate[:SCALar]:POWer[:NORMal][:GMSK][:RESult]:LIMit:MATChing?	6.20
CONFigure:MODulation:CONTrol	6.30
CONFigure:MODulation:CONTrol:DEFault	6.30
CONFigure:MODulation:CONTrol:REPetition	6.30
CONFigure:MODulation:EREPorting	6.29
CONFigure:MODulation:LIMit:DEFault	6.32
CONFigure:MODulation:LIMit:LOWer:AVERage	6.32
CONFigure:MODulation:LIMit:LOWer:MODE	6.31
CONFigure:MODulation:LIMit:LOWer[:CURRent]	6.31
CONFigure:MODulation:LIMit:UPPer:AVERage	6.32
CONFigure:MODulation:LIMit:UPPer:MODE	6.31
CONFigure:MODulation:LIMit:UPPer[:CURRent]	6.31
CONFigure:POWer[:NORMal][:GMSK]:CONTrol	6.13
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault	6.14
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition	6.13
CONFigure:POWer[:NORMal][:GMSK]:EREPorting	6.12
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault	6.17
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>:MODE	6.17
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:NORMal]	6.16
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>:MODE	6.16
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:NORMal]	6.15
CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol	6.24
CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition	6.24
CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting	6.23
CONFigure:POWer[:NORMal][:GMSK]:TIME:MODE	6.17
CONFigure:POWer[:NORMal][:GMSK]<nr>:LIMit:LINE:LOWer<nr>[:NORMal]:ENABle	6.16
CONFigure:POWer[:NORMal][:GMSK]<nr>:LIMit:LINE:UPPer<nr>[:NORMal]:ENABle	6.15
CONFigure:RFGenerator:MODulation:BIT:SELection	6.6
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7 Remote Control – Program Examples

The following program examples illustrate how to solve typical measurement tasks in the *Non Signalling* and in the *Signalling* mode. To keep the syntax as short and simple as possible, the programs were written with the aid of *Winbatch*, a batch job tool organizing and simplifying the transfer of commands and data between the controller and the instrument.

Winbatch uses device names such as *CMUBASE, CMUGSMNS, CMUGSMSIG* which are previously defined and assigned to the primary address, secondary address, and some general device settings. With these device names, a complete command line reads:

```
CMUBASE: <CMU_Command>
```

where `<CMU_Command>` may be any of the commands (setting commands or queries) specified within the function group and mode identified by the device name *CMUBASE*. Program sequences consisting of commands that are defined in several function groups and modes can be re-used with an exchanged device name.

In addition to these data transfer commands, *Winbatch* provides *WHILE, GOTO*, and *IF* statements to express conditions and define loops. With the statement

```
WHILE CMUGSM: SENS:SIGN:STAT? <> SYNC
```

the instrument waits until it has reached the signalling state *Synchronized* before it executes the following commands.

For a C program assigning secondary addresses refer to chapter 7 of the CMU200 manual.

GSM-MS Non Signalling Measurements

The CMU generates a GSM signal which is configured, output via RF 3, fed in via RF 4, and measured with the appropriate analyzer settings. To see which analyzer settings are necessary, it is recommended to carry out the measurement manually first. Before doing so and running the program, connect RF 1 to RF 2 using a coax cable, in analogy to the test setup suggested in chapter 2. Also, configure your *Winbatch* settings such that *CMUBASE* is the device name for the CMU *BASE* system and *CMUGSMNS* denotes function group *GSM900-MS Non Signalling*.

```
ECHO ON

FPRINT ...............................................................................
FPRINT    INITIALISATION ROUTINE:
FPRINT    ASK FOR THE IDENTIFIER OF THE CMU, RESET THE INSTRUMENT,
FPRINT    DEFINE THE SECONDARY ADDRESSES FOR ALL AVAILABLE FUNCTION GROUPS
FPRINT ...............................................................................

CMUBASE: *IDN?                                 Identification query
CMUBASE: *RST;*OPC?                            Reset the instrument; prevent the following
                                                  command to be executed before *RST is
                                                  complete
CMUBASE: *CLS                                  Clear output buffer, set status byte
CMUBASE: SYST:REM:ADDR:SEC 1,"RF_NSig"         Define all function groups
CMUBASE: SYST:REM:ADDR:SEC 2,"GSM900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 3,"GSM900MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 4,"GSM1800MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 5,"GSM1800MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 6,"GSM1900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 7,"GSM1900MS_NSig"

FPRINT ...............................................................................
FPRINT   CONNECTORS + ATTENUATION
FPRINT .............................................................................

CMUGSMNS: INP:STAT RF4                          Define input connector RF2
CMUGSMNS: OUTP:STAT RF3                         Define output connector RF1
CMUGSMNS: SENS:CORR:LOSS:INP2 0.0               Make sure that external attenuations are set
CMUGSMNS: SENS:CORR:LOSS:OUTP2 0.0                 to zero

FPRINT .............................................................................
FPRINT    GENERATOR SETTINGS
FPRINT .............................................................................

CMUGSMNS: CONF:RFG:MOD:BIT:SEL DUMM             Select GSM dummy burst to be generated
CMUGSMNS: CONF:RFG:MOD:TSEQ:SEL GSM0            Select training sequence
CMUGSMNS: CONF:RFG:MOD:TRAN BURS                Select signal shape (burst signal)
CMUGSMNS: SOUR:RFG:FREQ:CHAN 900 MHZ            SetRF carrier frequency
CMUGSMNS: SOUR:RFG:LEV:UTIM -5                  Set RF level in used timeslot
CMUGSMNS: INIT:RFG;*OPC?                        Switch on RF generator

FPRINT .............................................................................
FPRINT    ANALYZER SETTINGS
FPRINT .............................................................................

CMUGSMNS: RFAN:CHAN 900 MHZ                     Adjust analyzer frequency to generator freq.
CMUGSMNS: RFAN:TSEQ GSM0                        Adjust training sequence analyzed
CMUGSMNS: SYST:ERR?                             Read error queue

FPRINT .............................................................................
FPRINT    CONFIGURE THE POWER MEASUREMENT
FPRINT .............................................................................

CMUGSMNS: CONF:POW:CONT SCAL,1                  Scalar results, one burst per statistics cycle
CMUGSMNS: CONF:POW:CONT:REP SING,NONE,NONE      Single shot measurement, no stop on error
CMUGSMNS: CONF:POW:MPR:CONT SCAL,1              Same settings as before, but for combined
CMUGSMNS: CONF:POW:MPR:CONT:REP SING,NONE,NONE     power and modulation measurement

FPRINT .............................................................................
FPRINT    SETTLE THE EXPECTED POWER (+OVERSHOOT MARGIN) AND MEASURE THE POWER
FPRINT    REMEMBER: RFG POWER -5 dBm
FPRINT .............................................................................

CMUGSMNS: LEV:MAX 0                             Adjust expected maximum level
CMUGSMNS: READ:POW:MPR?                         Start single shot measurement, wait until it is
                                                   terminated, and return scalar power and
                                                   modulation results

FPRINT .............................................................................
FPRINT    FREE TX MEASUREMENT DSP RESOURCES
FPRINT .............................................................................

CMUGSMNS: ABOR:POW:MPR                          Abort combined power/mod measurement,
                                                   free resources

FPRINT .............................................................................
FPRINT    RFG POWER -10 dBm, USING FASTER WIDEBAND PEAK POWER METER
FPRINT .............................................................................

CMUGSMNS: SOUR:RFG:LEV:UTIM -10;*OPC?           Select RF level in used timeslot
CMUGSMNS: LEV:MAX -5                            Adjust expected maximum level
CMUGSMNS: READ:SPOW?                            Start single shot wide band peak power
                                                   measurement, wait until it is terminated,
                                                   and return result
```

The measurement can be easily repeated at other RF levels or with different configurations.

GSM Signalling Measurements

A GSM mobile phone is connected to the bidirectional connector RF2 as described in chapter 2 and tested. We assume that the mobile phone is capable of operating in the GSM900 band; in the example involving a GSM900/1800 handover, an appropriate dual-band mobile must be used. Moreover, a test SIM card for the mobile phone is required.

Call Setup to the Mobile Phone, Simple RX/TX Measurements

Preliminary configurations for a power and sensitivity measurement are defined, and the network parameters are set for maximum speed of the call procedure. The IMSI of the mobile phone must be known to set up a call; it can be either reported to the tester or will be determined during the location update. The first alternative will speed up the call procedure.

Next, the CMU generates a BCCH (C0 carrier) signal for synchronization. The mobile phone searches the whole channel range for this BCCH and camps on it for some mobile-specific time until it reaches the *Synchronized* state. In this state, configuration settings made at the beginning are checked, and the CMU sets up a call to the mobile phone. Parameters such as the PCL and channel should be defined before the call is setup to reduce signalling time (no PCL/channel change). As soon as the call is established, power and sensitivity measurements are performed.

Before running the program, configure your *Winbatch* settings such that *CMUBASE* is the device name for the CMU *BASE* system and *CMUGSM* denotes function group *GSM900-MS Signalling*.

```
ECHO ON

FPRINT ..........................................................................
FPRINT    INITIALISATION ROUTINE:
FPRINT    ASK FOR THE IDENTIFIER OF THE CMU, RESET THE INSTRUMENT,
FPRINT    DEFINE THE SECONDARY ADDRESSES FOR ALL AVAILABLE FUNCTION GROUPS
FPRINT ..........................................................................

CMUBASE: *IDN?                                  Identification query
CMUBASE: *RST;*OPC?                             Reset the instrument; prevent the following
                                                  command to be executed before *RST is
                                                  complete
CMUBASE: *CLS                                   Clear output buffer, set status byte
CMUBASE: SYST:REM:ADDR:SEC 1,"RF_NSig"          Define all function groups
CMUBASE: SYST:REM:ADDR:SEC 2,"GSM900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 3,"GSM900MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 4,"GSM1800MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 5,"GSM1800MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 6,"GSM1900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 7,"GSM1900MS_NSig"

FPRINT ...........................................................................
FPRINT   CONNECTORS + ATTENUATION
FPRINT ...........................................................................

CMUGSM: INP:STAT RF2                            Define input connector RF2
CMUGSM: OUTP:STAT RF2                           Define output connector RF2
CMUGSM: SENS:CORR:LOSS:INP2 1.0                 Define external attenuation to compensate
CMUGSM: SENS:CORR:LOSS:OUTP2 1.0                  for known cable losses

FPRINT ...........................................................................
FPRINT   NETWORK PARAMETERS, SELECTED FOR MAXIMUM SPEED OF THE CALL PROCEDURE
FPRINT   THE IMSI REQUIRED MAY DIFFER FROM THE EXAMPLE (=DEFAULT) SETTINGS
FPRINT ...........................................................................

CMUGSM: CONF:NETW:SMOD:IMSI:MNC 001;MCC 01;MSIN '1000000095'      Set IMSI
CMUGSM: CONF:NETW:REQ:IMSI OFF                  Switch IMSI request off
```

```
CMUGSM: CONF:NETW:REQ:IMEI OFF                    Switch IMEI request off
CMUGSM: CONF:NETW:REQ:AUTH OFF                    Switch authentication request off
CMUGSM: CONF:NETW:REQ:HAND OFF                    Switch handover request off
CMUGSM: CONF:NETW:SMOD:SCH FACC                   Signalling via FACCH
CMUGSM: CONF:NETW:SMOD:PCH FAST                   Fast power change (over FACCH)

FPRINT .............................................................................
FPRINT   CONFIGURATION OF A SINGLE SHOT BER MEASUREMENT
FPRINT .............................................................................

CMUGSM: CONF:SENS:SSH:CONT:HTIM 0.2,0.0           Reduce holdoff times for AGC and
                                                    bit stream synchronization
CMUGSM: CONF:SENS:SSH1:CONT:LEV:UTIM -102.0       Absolute level in used timeslot
CMUGSM: CONF:SENS:SSH1:CONT:LEV:UNT -20.0         Relative level in unused timeslot
CMUGSM: CONF:SENS:SSH1:CONT:REP NONE,NONE         No stop on error
CMUGSM: CONF:SENS:SSH1:CONT BER,129               Bit error rate measurement over 129 frames
CMUGSM: CONF:SENS:SSH:TSET AP1                    Store configuration in test setup 1


FPRINT .............................................................................
FPRINT   CONFIGURATION OF A SINGLE SHOT POWER MEASUREMENT
FPRINT .............................................................................

CMUGSM: CONF:POW:MPR:CONT SCAL,10                 Scalar results, 10 bursts per statistics cycle
CMUGSM: CONF:POW:MPR:CONT:REP SING,NONE,NONE      Single shot measurement, no stop on error


FPRINT .............................................................................
FPRINT   DEFINITION FOR BCCH BS POW: -85 dBm / Channel 5
FPRINT .............................................................................

CMUGSM: CONF:BSS:CCH:LEV -85.0;*OPC?              Absolute power of BCCH BS signal
CMUGSM: CONF:BSS:CCH:CHAN 30;*OPC?                Channel number of BCCH BS signal

FPRINT .............................................................................
FPRINT   DEFINITION FOR TESTSET BS POW: -85 dBm (-102 dBm) / Channel 1 / PCL 5
FPRINT .............................................................................

CMUGSM: CONF:BSS:TCH:LEV:UTIM -85.0;*OPC?         Absolute power of TCH BS signal, used TS
CMUGSM: CONF:BSS:CHAN 1;*OPC?                     Channel number of TCH BS signal
CMUGSM: CONF:NETW:POW 5;*OPC?                     Power control level of the mobile
                                                    setting up a call

FPRINT .............................................................................
FPRINT   GENERATING THE BCCH
FPRINT .............................................................................

CMUGSM: PROC:SIGN:ACT SON;*OPC?                   Switch on BCCH signal

FPRINT .............................................................................
FPRINT   WAIT FOR LOCATION UPDATE
FPRINT .............................................................................

REPORT OFF
WHILE CMUGSM: SENS:SIGN:STAT? <> SYNC             Wait until signalling state Synchronized is
                                                    reached, then go to next command
REPORT ON

FPRINT .............................................................................
FPRINT   CALL PROCEDURE (CHECK IMSI IF THIS PROCEDURE FAILS)
FPRINT .............................................................................

CMUGSM: PROC:SIGN:ACT MTC;*OPC?                   Initiate a mobile terminating call

FPRINT .............................................................................
FPRINT   REDUCE THE BS POWER. THIS AFFECTS THE BER BUT NOT THE TX MEASUREMENTS
FPRINT .............................................................................
```

```
CMUGSM: PROC:BSS:LEV:UTIM -102;*OPC?             Absolute power of TCH BS signal, used TS

FPRINT ..........................................................................
FPRINT   START THE SINGLE SHOT BER (SENS:SSH) AND THE POWER/MODULATION MEASUREMENT
FPRINT   THE TX MEASUREMENTS ARE FASTER AND WILL BE FINISHED FIRST
FPRINT   WHILE THE SENS:SSH MEAS. IS RUNNING THE RXLEV AND RXQUAL CAN BE QUERIED
FPRINT ..........................................................................

CMUGSM: INIT:SENS:SSH;*OPC?                      Initiate single shot BER measurement
CMUGSM: INIT:POW:MPR;*OPC?                       Initiate combined power/mod. measurement

WHILE CMUGSM: FETC:POW:MPR:STAT? !{} RDY         Wait until power/mod. measurement is in the
                                                 RDY (ready) state, then go to next command
CMUGSM: FETC:POW:MPR?                            Return scalar power/mod. results

[MEAS1_1]
IF CMUGSM: FETC:SENS:SSH:STAT? {} RDY GOTO MEAS1_2Check whether BER measurement is ready
CMUGSM: RREP:RXL?                                Return RXLev reported by the mobile
CMUGSM: RREP:RXQ?                                Return RXQual reported by the mobile
GOTO MEAS1_1
[MEAS1_2]
CMUGSM: FETC:SENS:SSH?                           Read out BER measurement results
```

To change the traffic channel without dropping the call, use the `PROC:SIGN:CHAN` command. To change the PCL of the mobile, use `PROC:SIGN:MS:PCL`. To change both parameters simultaneously, use `PROC:SIGN:CHCC`.

Handover

The example of the last section is repeated for a GSM900/1800 dual-band mobile phone. To this end, extend your *Winbatch* settings such that *CMUDCS* denotes function group *GSM1800-MS Signalling*. Repeat and modify the program of the last section in the following way:

- ➢ Before the BCCH signal is generated, set the parameters for call setup and for the measurements in function group *GSM1800-MS Signalling:*

```
CMUDCS: INP:STAT RF2                             Define input connector RF2
CMUDCS: OUTP:STAT RF2                            Define output connector RF2
CMUDCS: SENS:CORR:LOSS:INP2 2.0                  Define external attenuation to compensate
CMUDCS: SENS:CORR:LOSS:OUTP2 2.0                    for known cable losses

CMUDCS: CONF:NETW:SMOD:PCH FAST                  Fast power change (over FACCH)

CMUDCS: CONF:SENS:SSH:CONT:HTIM 0.2,0.0          Reduce holdoff times for AGC and
                                                    bit stream synchronization
CMUDCS: CONF:SENS:SSH1:CONT:LEV:UTIM -102.0      Absolute level in used timeslot
CMUDCS: CONF:SENS:SSH1:CONT:LEV:UNT -20.0        Relative level in unused timeslot
CMUDCS: CONF:SENS:SSH1:CONT:REP NONE,NONE        No stop on error
CMUDCS: CONF:SENS:SSH1:CONT BER,129              Bit error rate measurement over 129 frames
CMUDCS: CONF:SENS:SSH:TSET AP1                   Store configuration in test setup 1

CMUDCS: CONF:POW:MPR:CONT SCAL,10                Scalar results, 10 bursts per statistics cycle
CMUDCS: CONF:POW:MPR:CONT:REP SING,NONE,NONE     Single shot measurement, no stop on error

CMUDCS: CONF:BSS:CHAN 512                        Channel number of TCH BS signal
CMUDCS: CONF:NETW:POW 5                          Power control level of the mobile
                                                    setting up a call
```

- ➢ Generate the BCCH signal and set up the call as shown in the previous section. This means that the mobile operates on the GSM900 band while the signalling procedures are carried out.

- As soon as the call is established `SENSitivity` and other measurements can be performed in the GSM900 band. Instead initiate a dual-band handover to GSM1800:

```
FPRINT .............................................................................
FPRINT   DUALBAND HANDOVER
FPRINT .............................................................................

CMUGSM: CONF:HAND:TARG 'GSM1800MsDualBand'           Define target band for handover
CMUGSM: PROC:SIGN:ACT HAND;*OPC?                     Initiate handover procedure

REPORT OFF
WHILE CMUDCS: SENS:SIGN:STAT? <> CED                 Wait until signalling state Call Established
                                                        Dualband is reached, then continue
REPORT ON

CMUDCS: SENS:SIGN:STAT?                              Query signalling state (printout)

FPRINT .............................................................................
FPRINT   CHANNEL 512, PCL 0
FPRINT .............................................................................

CMUDCS: INIT:SENS:SSH                                Initiate single shot BER measurement
CMUDCS: INIT:POW:MPR                                 Initiate combined power/mod. measurement

WHILE CMUDCS: FETC:POW:MPR:STAT? !{} RDY             Wait until power/mod. measurement is in the
                                                     RDY (ready) state, then go to next command
CMUDCS: FETC:POW:MPR?                                Return scalar power/mod. results

FPRINT .............................................................................
FPRINT   CALL RELEASE
FPRINT .............................................................................

CMUDCS: PROC:SIGN:ACT CREL;*OPC?
```

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